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Measuring the international mobility of skilled workers (1990-2000) - Release 1.0

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Abstract

In this paper, we provide new estimates of skilled workers' emigration rates for about 190 countries in 2000 and 170 countries in 1990, including both developing and industrial countries. Using various statistical sources, we revisit Carrington and Detragiache's measures by incorporating information on immigrants' educational attainment and country of origin from almost all OECD countries. Our database covers 92.7 percent of the OECD immigration stock. In absolute terms, we show that the largest numbers of highly educated migrants are from Europe, Southern and Eastern Asia and, to a lesser extent, Central America. Nevertheless, as a proportion of the potential educated labor force, the highest brain drain rates are observed in the Caribbean, Central America, Western and Eastern Africa. Repeating the exercise for 1990 and 2000 allows us to evaluate the changes in brain drain intensity. Western Africa, Eastern Africa and Central America experienced a remarkable increase in the brain drain during the past decade.

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NON-TECHNICAL SUMMARY

Until recently, there has been no systematic empirical assessment of the economic impact of the brain drain. Despite many case studies and anecdotal evidence, the main reason for this seems to be the lack of harmonized international data on migration by country of origin and education level. An exception is the paper by Carrington and Detragiache (1998) which provided skilled migration rates for 61 developing countries in 1990. This study relies on a set of tentative assumptions. For example, they transpose the skill structure of US immigrants on the OECD total immigration stock.

In this paper, we provide new estimates of skilled workers' emigration rates for about 190 countries in 2000 and 170 countries in 1990, including both developing and industrial countries. Using various statistical sources, we revisit Carrington and Detragiache's measures by incorporating information on immigrants' educational attainment and country of origin from almost all OECD countries. The set of receiving countries is restricted to OECD nations. Our database covers 92.7 percent of the OECD immigration stock.

In absolute terms, we show that the largest numbers of highly educated migrants are from Europe, Southern and Eastern Asia and, to a lesser extent, from Central America. Nevertheless, as a proportion of the potential educated labor force, the highest brain drain rates are observed in the Caribbean, Central America, and Western and Eastern Africa. Repeating the exercise for 1990 and 2000 allows us to evaluate the changes in brain drain intensity. Western Africa, Eastern Africa and Central America experienced a remarkable increase in the brain drain during the past decade.

Our database delivers information that is rich enough to assess the changes in the international distribution of migration rates, to test for the (push and pull) determinants per skill group, to evaluate the growth effects of migration on source and destination countries or to estimate the relationships between migration, trade, foreign R&D and remittances.

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1 Introduction

In a narrow economic sense, brain drain denotes the international transfers of human resources. Such transfers have undergone extensive scrutiny in developing countries, but also in industrial countries such as Canada, the United Kingdom or Germany, where an important fraction of talented workers are working abroad. There is a fair amount of evidence suggesting that the brain drain is now much more extensive than it was 2 or 3 decades ago. For example, Haque and Jahangir (1999) indicate that the number of highly skilled emigrants from Africa increased from 1,800 a year on average during the 1960-75 period to 4,400 during 1975-84 and 23,000 during 1984-87. These trends were confirmed in the 1990s in the face of the increasingly "quality-selective" immigration policies introduced in many OECD countries[1]. Since 1984, Australia's immigration policy has officially privileged skilled workers, with the candidates being selected according to their prospective "contribution to the Australian economy". Canadian immigration policy follows similar lines, resulting in an increasing share of highly educated people among the selected immigrants; for example, in 1997, 50,000 professional specialists and entrepreneurs immigrated in Canada with 75,000 additional family members, representing 58% of total immigration. In the US, since the Immigration Act of 1990 - followed by the American Competitiveness and Work Force Improvement Act of 1998 - emphasis has been put on the selection of highly skilled workers, through a system of quotas favoring candidates with academic degrees and/or specific professional skills. For the latter category, the annual number of visas issued for highly skilled professionals (H-1B visas) increased from 110,200 in 1992 to 355,600 in 2000, the totality of this increase being due to immigration from developing countries. About half of these workers now come from India. In EU countries, immigration policies are less clear and still oriented toward traditional targets such as asylum seekers and applicants requesting family reunion. However, there is some evidence suggesting that European countries are also leaning toward becoming quality-selective. As reported in Lowell (2002b), "European Commission President Prodi has called for up to 1.7 million immigrants to fill a EU-wide labor shortage through a system similar to the US green cards for qualified immigrants". A growing number of EU countries (including France, Ireland and the UK) have recently introduced programs aiming at attracting a qualified workforce (especially in the field of information, communication and technology - ICT) through the creation of labor-shortage occupation lists (see Lowell, 2002a). In Germany in February 2000, Chancelor Schröder announced plans to recruit additional specialists in the field of information technology. The Green cards came into force in August 2001, giving German ICT-firms the opportunity to hire up to 20,000 non-EU ICT-specialists for a maximum of five years. More recently, the German Sübmuth-Commission recom-

[1]According to our calculations, the number of immigrants with tertiary education increased by about 50,000 a year between 1990 and 2000. Tertiary education refers to more than secondary education (more than high school).

mended the introduction of a coherent flexible migration policy that allows for both temporary and permanent labor migrants (see Bauer and Kunze, 2004). In France, the Ministry of Labor established in 2002 a system to induce highly skilled workers from outside the EU to live and work in France. Given the apparent demographic problems and the aging of populations, the intensity of the brain drain could increase further during the next decades[2].

What are the consequences for sending countries? The early literature - which dates back to the 1960s and 1970s (Grubel and Scott, 1966, Johnson, 1967, Bhagwati and Hamada, 1974, Kwok and Leland, 1982) - supports the view that skilled migration is bad for those left behind. This is the case if the migrants' contribution to the economy is greater than his/her marginal product and/or if the education of skilled emigrants was partly funded by taxes on residents. The negative effects of the brain drain for source countries have been reformulated in an endogenous growth framework (Miyagiwa, 1991, Haque and Kim, 1995, Wong and Yip, 1999). More recently, the effects of migration prospects on human capital formation have been the focus of several studies (Mountford, 1997, Stark *et al.*, 1998, Vidal, 1998, Beine *et al.*, 2001), suggesting that such prospects may in fact *foster* human capital formation and growth in sending countries. The essence of the argument is that if the return to education is higher abroad than at home, the possibility of migration increases the expected return to human capital, thereby enhancing domestic enrollment in education[3]. More people, therefore, invest in human capital as a result of increased migration opportunities. This acquisition can contribute positively to growth and economic performance. Alongside the incentives to acquire education, other channels through which the brain drain may positively affect the sending economy have also been proposed. These include a range of "feedback effects" such as remittances (Cinar and Docquier, 2004), return migration after additional knowledge (Stark and Helmenstein, 1997, Domingues Dos Santos and Postel Vinay, 2003) and skills have been acquired abroad, and the creation of business and trade networks (Dustmann and Kirchkamp, 2002, Mesnard and Ravallion, 2002)

Understanding and measuring all the mechanisms at work would obviously help designing adequate policy responses to the brain drain. Until recently, there has been no systematic empirical assessment of the economic impact of the brain drain. Despite many case studies and anecdotal evidence, the main reason for this seems to be the lack of harmonized international data on migration by country of origin and education level (see Commander et al, 2004). In the absence of such empirical material, the debate has remained almost exclusively theoretical. In their influential contribution, Carrington and Detragiache (1998, 1999) provided estimates of the

[2]See IOM (2003) and World Bank (2003) on the perspectives of brain drain in the twenty-first century.

[3]According to the IOM (2003), "prospects of working abroad have increased the expected return to additional years of education and led many people to invest in more schooling, especially in occupations in high demand overseas".

emigration rates of tertiary educated workers for 61 developing countries. These estimates are based on three main statistical sources (US Census data on the skill structure of immigration, OECD data on immigration per country of origin, Barro and Lee (2000) data describing the skill structure in sending countries). They had to rely on a set of assumptions. First, for non-US countries, they use OCDE migration statistics which report limited information on the origin of immigrants[4]. Second, they transpose the skill structure of US immigrants on the OECD total immigration stock. For example, migrants from South Africa to Great Britain are assumed to be distributed across educational categories in the same way as migrants from South Africa to the United States. This assumption is particularly tentative for countries which do not send many migrants to the United States. Adams (2003) used the same methodology to update the emigration rates of 24 labor-exporting countries in 2000. Beine et al (2003) used Carrington and Detragiache's data to predict the growth impact of the brain drain. Yet, given the assumptions, the evidence concerning the consequences of skilled migration for developing countries remains not only limited but also largely inconclusive.

The purpose of this paper is to build an exhaustive international database on the brain drain describing the loss of skilled workers for all developing and developed countries. The majority of high-skilled workers go to industrialized countries. Building on Carrington and Detragiache (1998) and Adams (2003), we focus on the South-North and North-North brain drain. We are aware that a brain drain can be observed outside the OECD area (migration of skilled workers to the Gulf countries, South Africa, Malaysia, Hong-Kong, Singapore, Taiwan, etc) but, at this stage, we do not take these flows into account[5].

We collected data on the immigration structure by educational attainment and country of birth from all OECD receiving countries. Census and register data are (or will be) available for about 25 countries in 2000 (out of 30 OECD countries). To allow comparison between 1990 and 2000, we consider the same number of receiving countries in 1990 (even if six of them were not members of the OECD). Census data are (or will be) available for about 18 countries in 1990. Survey data and reasonable assumptions can be used to evaluate the structure of immigration in the remaining countries.

In this release of the database, we also use survey data for countries in which the Census is not yet available in the desired format (i.e. for 12 European countries). At this stage, we estimate that we are able to characterize the country of birth and the educational attainment of 92.7 percent of the OECD stock of adult immigrants in

[4]OCDE statistics suffer from various limitations (see OCDE, 2002) . For example, they only provide information on the country of origin for the the main sending countries. In 2000, they are not avalaible for Greece, Iceland, Mexico, Slovakia, Turkey.

[5]According to the United Nations (2002), migration to developed countries represented 53 percent of the world migration in 1990 and 60 percent in 2000. High-skill migration is even more concentrated. In this study, we estimate that about 85 percent of high-skill migrants go to OECD countries.

2000 (and 88.8% of the stock in 1990). For the remaining 7.3 percent (11.2 percent in 1990), we usually have information on the country of origin but have to extrapolate the skill structure on the basis of available information. In the spirit of the Carrington and Detragiache or Adams studies, a method based on the US census requires extrapolating the skill structure on the basis of 42 percent of the total OECD stock (36 percent in 1990). Our paper is a strong improvement on earlier efforts.

Our method allows to distinguish about 190 sending countries in 2000 and 170 countries in 1990 (before the secession of the Soviet block, ex-Yugoslavia and ex-Czechoslovakia). Our measures can be used to examine the changes in the international distribution of migration rates, to test for the (push and pull) determinants per skill group, or to evaluate the macroeconomic consequences of migration on source and destination countries.

The remainder of this paper is organized as follows. Section 2 describes the methodology. Emigration rates for 1990 and 2000 are presented in Section 3. Section 4 presents the key indicators of skilled migration. Finally, Section 6 concludes.

2 Methodology

This section describes the methodology and the data sources used to compute emigration rates of skilled workers for a large set of sending countries. Building on Carrington and Detragiache, we define the brain drain as the proportion of working age individuals (aged 25 and over) with at least tertiary educational attainment, born in a given country but living in another country, taking into account neither their occupation, nor where education took place, nor when they arrived. To build such indicators, we proceed in two steps. We first compute emigration stocks by educational attainment from all countries of the world. Then, we evaluate these numbers as a proportion of the labor force born in the sending country. This gives emigration rates per educational attainment.

These two steps rely on various assumptions. We distinguish the general assumptions required when all existing data are collected and the specific assumptions inherent to this particular release of the database (some information is estimated on the basis of survey data). These specific assumptions will be progressively relaxed as new official statistics become available.

2.1 Step 1 - Emigration stocks

International emigration data are usually not available or of bad quality. Hence, brain drain can only be captured by aggregating consistent immigration data collected in receiving countries. Information about the origin and skill of natives and immigrants is available from national population Censuses. More specifically, country i's Census usually identifies individuals on the basis of age, country of birth j, and skill level s.

Methodology. Our method consists in collecting Census or register data from a large set of receiving countries, with the highest level of detail on birth countries and (at least) three levels of educational attainment: $s = h$ for high skilled, $s = m$ for medium skilled, $s = l$ for low skilled and $s = u$ for unknown. Low skilled workers are those with primary education (or with 0 to 8 years of schooling in countries where the highest diploma is not provided); medium skilled workers are those with secondary education (9 to 12 years of schooling); high skilled workers are those with tertiary education (13 years and above). The unknowns are either due to the fact that some immigrants did not declare their educational attainment or to the absence of data in some receiving countries. Educational categories are built on the basis of country specific information and are compatible with Barro and Lee data on education in the sending countries. A mapping between the country educational classification is sometimes required to harmonize the data[6]. Let $M_{t,s}^{i,j}$ denote the stock of adult individuals born in j, of skill s, living in country i at time t.

Building an aggregate measure of emigration per educational attainment requires a rule for sharing the unknown values. Two resonable rules could be considered: either unknown values can be distributed in the same way as the known values or they can be assimilated to unskilled. We combine both rules depending on the information available in the receiving country. For receiving countries where information about immigrants' education is available, we assimilate unknowns to unskilled workers. For example, Australian immigrants who did not mention their educational attainment are considered as unskilled. In receiving countries where no information about skill is available, we transpose the skill distribution observed in the rest of the OECD area. Note that the latter skill distribution is specific to each country of birth. For example, if we have no information about the skill structure of immigrants to Italy, Algerian emigrants to Italy are assumed to be distributed in the same way as Algerian emigrants to the rest of the OECD area.

Formally, the stocks of emigrants of skill s from country j at time t ($M_{t,s}^{\cdot j}$) are obtained as follows:

$$M_{t,h}^{\cdot j} = \sum_i M_{t,h}^{i,j} + \sum_i M_{t,u}^{i,j} \times \Upsilon_t^i \times \frac{\sum_i M_{t,h}^{i,j}}{\sum_i \left[M_{t,l}^{i,j} + M_{t,m}^{i,j} + M_{t,h}^{i,j} \right]}$$

$$M_{t,m}^{\cdot j} = \sum_i M_{t,m}^{i,j} + \sum_i M_{t,u}^{i,j} \times \Upsilon_t^i \times \frac{\sum_i M_{t,m}^{i,j}}{\sum_i \left[M_{t,l}^{i,j} + M_{t,m}^{i,j} + M_{t,h}^{i,j} \right]}$$

$$M_{t,l}^{\cdot j} = \sum_i M_{t,l}^{i,j} + \sum_i M_{t,u}^{i,j} \times \Upsilon_t^i \times \frac{\sum_i M_{t,l}^{i,j}}{\sum_i \left[M_{t,l}^{i,j} + M_{t,m}^{i,j} + M_{t,h}^{i,j} \right]} + \sum_i M_{t,u}^{i,j} \times (1 - \Upsilon_t^i)$$

[6]For example, Australian data mix information about the highest degree and the number of years of schooling.

where Υ_t^i is a (time and country dependent) binary variable equal to one if there is no data on the immigrants' skill in country i, and equal to zero otherwise.

Shortcomings. Our methodology is imperfect and could be improved in many ways. However, we believe that our estimates can be reasonably used to examine the changes in the international distribution of migration rates, to test for the (push and pull) determinants of skilled migration. Let us discuss some shortcomings.

A first limit of our analysis is that the set of receiving countries is restricted to OECD nations. Generally speaking, the skill level of immigrants in non-OECD countries is expected to be very low, except in a few countries such as South Africa (1.3 million immigrants in 2000), the Gulf countries (9.6 million immigrants in Saudi Arabia, United Arab Emirates, Kuwait, Barhain, Oman and Qatar), some Eastern Asian countries (4 million immigrants in Hong-Kong and Singapore only). According to their census data, about 17.5 percent of adult immigrants are tertiary educated in these countries (17 percent in Bahrain, 17.2 percent in Saudi Arabia, 14 percent in Kuwait, 18.7 in South Africa). Considering that children constitute 25 percent of the immigration stock, we estimate the number of educated workers at 1.9 million in these countries. The number of educated people in the rest of the world lies between 1 and 4 million (if the proportion of educated immigrants among adults lies between 2.5 and 10 percent). This implies that focusing on OECD countries, we should capture a large fraction of the world-wide educated immigration (about 85 percent). Nevertheless, we are aware that by disregarding non-OECD immigration countries, we probably underestimate the brain drain for a dozen of developing countries (such as Egypt, Sudan, Jordan in the neighborhood of the Gulf States, Namibia, Zimbabwe and other countries which send emigrants to South Africa, etc.).

Another point is that, by focusing on census and register data, our methodology does not capture illegal immigration for which systematic statistics by education level and country of origin are not available. Because illegal immigrants are mostly less educated, we obviously overestimate the average level of education of the immigrant population. Nevertheless, this limit should not significantly distort our estimates of the migration rate of highly skilled workers.

Only taking into consideration the population aged 25 and over maximizes the comparability of the immigration population with the Barro and Lee data on educational attainment in source countries. It also excludes a large number of students who emigrated to complete their education. We cannot control for graduate students aged 25 and over completing their schooling[7]. Note that, in a limited number of OECD countries identified below, we are unable to distinguish between young and adult immigrants.

A related problem is that we have no information on the age of entry. It is

[7]Carrington and Detragiache (1998) used data from the Institute of International Education to estimate the number of graduate students completing their schooling in the United States. We consider that some of these students aged 25 and over receive grants and can be considered as workers (researchers).

therefore impossible to distinguish between immigrants who were educated at the time of their arrival and those who acquired education after they settled in the receiving country; for example, Mexican-born individuals who arrived in the US at age 5 or 10 and graduated from US high-education institutions are counted as highly-skilled immigrants. Hence, our definition of the brain drain is clearly determined by data availability. Existing data do not allow us to systematically eliminate foreign-born individuals arrived with completed schooling or after a given age threshold.

In the US, the proportion of foreign born who arrived before age 15 (i.e. those who spent part of their schooling time in the US) represents 7.5 percent of the immigration stock. Since we have no systematic data for the other countries, we cannot control for children immigration.

Finally, the concept of immigration is not fully homogenous between countries. When the information exists, we define migration on the basis of the country of birth rather than citizenship. This concept is recommended by the United Nations[8] and better captures the decision to emigrate[9]. Another reason is that the concept of country of birth is time invariant, contrary to citizenship which changes with naturalization. The OECD statistics report that 14.4 millions of foreign born were naturalized between 1991 and 2000. Countries where the number of acquisitions of citizenship is particularly high are the US (5.6 million), Germany (2.2 million), Canada (1.6 million), Australia and France (1.1 million). Data by country of birth are available in a large majority of OECD countries. However, for some countries, immigrants are only classified by citizenship (Germany, Greece, Italy, Japan and Korea).

The first six columns in table 1 describe the availability of immigration data in OECD countries as well as the statistical sources. Some of these data are not available yet. Hence, provisory assumptions are used in this release of the database.

[8]In the International Migration Report (UN, 2002), the concept of country of birth is used for 159 countries while citizenship is used for 51 countries.

[9]In some receiving countries such as Germany, immigrants' children keep their foreign citizenship.

Table 1. Data sources and assumptions

2000	Data on the stock of immigrants	Definition of immigrants	Main source	Age	Education	Additional - and temporary - assumptions in release 1.0 (see footnote)
Australia	Census	Count. Birth	Australian Bureau of Stat.	25+	Avail.	-
Austria	Census	Count. Birth	Central Statistical Office	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Belgium	Census	Count. Birth	National Institute of Stat.	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Canada	Census	Count. Birth	Stat. Canada	25+	Avail.	-
Czech Rep	Census	Count. Birth	Czeck statistical office	25+	Avail.	-
Denmark	Admin. register	Count. Birth	Stat. Danemark	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Finland	Admin. register	Count. Birth	Statistic Finland	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
France	Census	Count. Birth	Nat. Inst. of Stat. and Econ. studies	25+	Avail.	-
Germany	Microcensus	Citizenship	German Mircocensus	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Greece	Census	Citizenship	European Council + Labor Force Survey	Estim.	Estim.	-
Hungary	Census	Count. Birth	Hungarian Central Statistic Office	25+	Avail.	-
Iceland	Admin. register	Count. Birth	Stat. Iceland	Total	Not Avail.	-
Ireland	Census	Count. Birth	Central Stat. Office	25+	Avail.	Count. birth estimated on Irish Census. Educ. attainment & share of 25+ on LFS
Italy	Census	Citizenship	National Statistical Institute	25+	Avail.	Citizenship estimated on EC. Educ. attainment as the rest of OECD
Japan	Admin. register	Citizenship	Ministry of Justice	Total	Not Avail.	-
Korea	Population register	Citizenship	National Statistical Office	Total	Not Avail.	-
Luxemburg	Census	Count. Birth	Nat. Inst. of Stat. and Econ. studies	25+	Avail.	-
Mexico	Census	Not Avail.	None	Total	Not Avail.	-
Netherlands	Census	Count. Birth	Statistic Netherlands	15+	Estim.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
New Zealand	Census	Count. Birth	Stat. New Zeland	15+	Avail.	-
Norway	Admin. register	Count. Birth	Stat. Norway	25+	Avail.	Citizenship estimated on EC. Educ. attainment as the rest of OECD
Poland	Census	Count. Birth	Central Statistical Office	13+	Avail.	-
Portugal	Census	Count. Birth	National Institute of Stat.	25+	Avail.	Educ. attainment as the rest of OECD
Slovak Rep	Census	Count. Birth	Statistical office of the Slovak Rep	25+	Avail.	-
Spain	Census	Count. Birth	Instituto national de estadistica	25+	Avail.	Educ. attainment & share of 25+ on LFS
Sweden	Census	Count. Birth	Stat. Sweden	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Switzerland	Census	Count. Birth	Swiss Federal Statistical Office	18+	Avail.	-
Turkey	Census	Count. Birth	State institute of Stat.	25+	Avail.	-
United Kingdom	Census	Count. Birth	National Stat.	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
United States	Census 1% sample	Count. Birth	US Burau of Census (IPUMS)	25+	Avail.	IPUMS Sample 1%

Notes (*): *EC = European Council data providing the immigration structure by country of citizenchip for European data*
LFS = European Labor Force Survey data providing data on country of birth and educational attainment in EU-15 countries

Table 1. Continued

1990	Data on the stock of immigrants	Definition of immigrants	Source	Age group	Education	Additional - and temporary - assumptions in release 1.0 (see footnote)
Australia	Census	Count. Birth	Australian Bureau of Stat.	25+	Avail.	-
Austria	Census	Count. Birth	Central Statistical Office	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Belgium	Census	Count. Birth	National Institute of Stat.	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Canada	Census	Count. Birth	Stat. Canada	25+	Avail.	-
Czech Rep	European Council	Citizenship	European Council	Not Avail.	Not Avail.	-
Denmark	Admin. register	Count. Birth	Stat. Danemark	25+	Estim.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Finland	Admin. register	Count. Birth	Statistic Finland	25+	Avail.	Educ. attainment as the rest of OECD
France	Census	Count. Birth	Nat. Inst. of Stat. and Econ. studies	25+	Avail.	-
Germany	Census	Citizenship	European Council	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Greece	Census	Citizenship	European Council	Estim.	Estim.	-
Hungary	European Council	Citizenship	European Council	Not Avail.	Not Avail.	Citizenship estimated on EC
Iceland	Admin. register	Count. Birth	Stat. Iceland	Total	Not Avail.	-
Ireland	Census	Count. Birth	Central Stat. Office	25+	Avail.	Count. birth estimated on Irish Census. Educ. attainment & share of 25+ on LFS
Italy	Census	Citizenship	National Statistical Institute	Not Avail.	Not Avail.	Citizenship estimated on EC. Educ. attainment as the rest of OECD
Japan	Admin. register	Citizenship	Ministry of Justice.	Total	Not Avail.	-
Korea	Population register	Citizenship	National Statistical Office	Total	Not Avail.	-
Luxemburg	Census	Count. Birth	Nat. Inst. of Stat. and Econ. studies	25+	Avail.	-
Mexico	Census	Not Avail.	None	Total	Not Avail.	-
Netherlands	Census	Count. Birth	Statistic Netherlands	15+	Estim.	Citizenship estimated on EC. Educ. attainment as the rest of OECD
New Zealand	Census	Count. Birth	Stat. New Zeland	15+	Avail.	-
Norway	Admin. register	Count. Birth	Stat. Norway	25+	Avail.	Citizenship estimated on EC. Educ. attainment as the rest of OECD
Poland	European Council	Citizenship	European Council	Total	Not Avail.	-
Portugal	Census	Count. Birth	National Institute of Stat.	25+	Avail.	Educ. attainment & share of 25+ on LFS
Slovak Rep	Included in Czech	-	-	-	-	-
Spain	Census	Count. Birth	Instituto national de estadistica	25+	Avail.	Educ. attainment & share of 25+ on LFS
Sweden	Census	Count. Birth	Stat. Sweden	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
Switzerland	Census	Count. Birth	Swiss Federal Statistical Office	18+	Avail.	-
Turkey	Census	Count. Birth	State institute of Stat.	25+	Avail.	-
United Kingdom	Census 10% sample	Count. Birth	National Stat.	25+	Avail.	Citizenship estimated on EC. Educ. attainment & share of 25+ on LFS
United States	Census 5% sample	Count. Birth	US Burau of Census (IPUMS)	25+	Avail.	IPUMS Sample 5%

Notes (*): *EC = European Council data providing the immigration structure by country of citizenchip for European data*
LFS = European Labor Force Survey data providing data on country of birth and educational attainment in EU-15 countries

Data available in 2000. Regarding the situation in 2000, we estimate the total stock of adult immigrants in the OECD area at 58.496 million. The only country for which data on age, country of birth and educational attainment are missing is Mexico (0.493 million of immigrants). Data on immigrants' age and educational attainment are not available for Japan, Iceland, Korea and Greece (2.030 million immigrants). However, the combination of European Council data and the European Labor Force Survey provides a good approximation of the Greek immigration structure (0.116 million adult immigrants). In the other 25 countries (55.974 million adult immigrants), Census and register data are (or will be) available. Adding Censuses and the Greek survey, we capture 56.090 million immigrants, i.e. 95.9% of the total. Finally, since about 1.8 million of those immigrants did not report their country of origin, we have accurate information on educational attainment and origin for 54.246 immigrant, i.e. 92.7% of the OECD adult immigration stock (to be compared with 44.1% in the US Census).

In the 26 countries (25 Census/Registers and Greece) where data on educational attainment will be available, we are usually able to work on the population aged 25 and over. However, this age limit is slightly different in some countries (18 in Switzerland, 15 in New Zealand, 13 in Poland). This should not distort our measure of the skilled immigration stock significantly. Contrary to common belief, data on country of birth are available in a large majority of countries, even in European countries. The concept of citizenship must only be used for Germany, Italy, as well as for Greece (European Council data are based on the concept of citizenship), Japan and Korea.

Data available in 1990. The methodology is similar for 1990. To allow comparisons between 1990 and 2000, we consider the same number of receiving countries in 1990 (even if Hungary, Poland, ex-Czechoslovakia, Korea and Mexico were not members of the OECD). Our counterfactual 1990 OECD zone includes 29 countries (Slovakia and the Czech Republic were unified). We estimate the total stock of adult immigrants in the OECD area at 39.844 million. Mexico is still the only country for which data on age, country of birth and educational attainment are missing (0.341 million immigrants). Data on immigrants' age and educational attainment are not available in ex-Czechoslovakia, Hungary, Poland, Italy, Japan, Iceland, Korea and Greece (2.641 million immigrants). However, combining European Council data and the European Labor Force Survey provides a good approximation for Greece and Italy (0.646 million adult immigrants). In the other 20 countries (36.862 million adult immigrants), Census or register data are (or will be) available. Adding Censuses, Italian and Greek surveys, we capture 37.508 million immigrants, i.e. 94.1% of the total. About 2.1 million of those immigrants did not report their country of origin. We have accurate information on educational attainment and origin for 35.385 million immigrants, i.e. 88.8% of the OECD adult immigration stock (to be compared with 38.5% in the US Census).

In the 22 countries (20 Censuses/Registers, Italy and Greece) where data on

educational attainment are available, age bounds are identical to those of 2000. The concept of citizenship must only be used for Germany and for all other countries where Census and register data are not available.

2.2 Step 2 - Emigration rates

The second step consists in comparing the emigration stocks to the number of remaining residents in the source country for the same three educational categories mentioned above. Calculating the brain drain as a proportion of the total educated labor force is a better strategy to evaluate the pressure imposed on the local labor market. It is indeed obvious that the pressure exerted by 1,096 thousand Indian skilled emigrants (4.5% of the educated total labor force) is less important than the pressure exerted by 76 thousand Surinamese (90.1% of the educated labor force).

This step requires using data on the skill structure of the adult population in the countries of origin. Denoting $N^j_{t,s}$ as the stock of individuals aged 25+, of skill s in country j, at time t, we define the emigration rates by

$$m^j_{t,s} = \frac{M^{\cdot j}_{t,s}}{N^j_{t,s} + M^{\cdot j}_{t,s}}$$

In particular, $m^j_{t,h}$ provides some information about the intensity of the brain drain in the source country j. It measures the fraction of skilled agents born in country j and living in other OECD countries[10].

Data for $N^j_{t,s}$ are taken from Barro and Lee (2000). For 1990 and 2000, they provide the adult population structure by educational attainment for about 120 countries. Barro and Lee's educational attainment measures are based on the highest level of schooling attained. Their measures are based on Census data when available. They provide perpetual inventory estimates based on historical schooling enrollment figures when Censuses are not available.

Combining Census and Survey data on immigration, we obtain the emigration stock for almost all the countries of the world (191 countries in 2000, 170 in 1990). For countries where Barro and Lee measures are missing (about 70 countries in 2000), we use the World Bank data on the population aged 25 and over and transpose the skill sharing of the bordering country with the closest GDP per capita. Note that the World Bank database provides the GDP per capita in PPP value for 155 countries. For a limited number of countries, the population aged 25 and over has been estimated by applying the share of the 25+ observed in the geographical area to

[10] For some countries, immigrants often travel back and forth between their new and old countries (e.g. Mexico). They are likely to be counted as still being residents in their home country. For that reason, Carrington and Detragiache (1998) provide an upper bound ($m = M/N$) and a lower bound ($m = M/(N + M)$). Since the upper bound is not interpretable for a large number of countries (higher than one), we only report the lower bound.

the total population size. We believe these two assumptions give good approximations of the brain drain rate, broadly consistent with anecdotal evidence.

2.3 Specific assumptions in release 1.0

Obtaining Census and Register data from all OECD countries is a long process involving numerous exchanges of information. Before data are available in the final desired format, adequate estimates can be provided on the basis of Survey data. This is especially the case for European countries where the Censuses for 2000 or 2001 are sometimes not yet available. In these cases, estimates can be obtained by crossing European Council, Register or Census data on the origin of immigrants, with Labor Force Survey data on education and age structures.

The last column in Table 1 describes the specific assumptions in release 1.0. Labor Force Survey data are used for 12 EU countries in 2000 and 1990 (Austria, Belgium, Denmark, Finland, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom) and immigrants' educational attainment in Norway is temporarily extrapolated on the basis of the available OECD countries. In 2000, while Census data will finally capture 55.974 million OECD immigrants (95.7% of the 2000 OECD stock), Release 1.0 uses Survey data for characterizing 13.626 million of them (23.3% of the 2000 stock). In 1990, Release 1.0 uses Survey data for identifying 8.315 million (20.9% of the 1990 OECD stock) out of 36.862 million immigrants for which Census data will be available (92.5% of the 1990 stock).

Such temporary assumptions[11] induce two major shortcomings. First, European Council data must be used for 10 countries. These data are based on the concept of citizenship (rather than country of birth). In all cases, information on the birth country will be available from the national Censuses. Second, the Labor Force Survey list of country of origin is usually less detailed than the Census list. The survey distinguishes 22 countries of origin and 10 groups of countries in 1990, 26 countries of origin and 13 groups of countries in 2000. The most striking example is Africa, which is divided in three groups (South Africa, Northern Africa and Other Africa). We compute the skill structure of emigration for these groups of countries and consider it as homogenous within groups. Despite this limitation, we attempted to a comparison between Labor Force Survey and Census data for France and obtained very accurate estimates for most African countries.

Note that we also use the Labor Force Survey to eliminate immigrants aged under 25. For countries where detailed data are not available, the share of young immigrants is also assumed to be homogenous within groups.

[11] The final database for 1990 and 2000 should be available by December 2004.

3 The database

Table 2 provides the emigration rates by educational category in 1990 and 2000. Countries are classified by geographical area. We distinguish 4 American areas (North America, the Caribbean, Central America and South America), 4 European areas (Northern Europe, Western Europe, Eastern Europe and Southern Europe), 5 African areas (Northern Africa, Central Africa, Western Africa, Eastern Africa and Southern Africa), 4 Asian areas (Western Asia, South-Central Asia, South-Eastern Asia and Eastern Asia) and 1 Oceanian area. Between 1990 and 2000, the world configuration changed. Czechoslovakia seceded into the Czech Republic and the Slovak Republic, the ex-USSR seceded into 15 countries (7 on the European continent and 8 on the Asian continent), Ex-Yugoslavia seceded into 5 countries, Eritrea emerged as a new country in 1993. To make comparisons possible, we compute information for ex-Yugoslavia, for the ex-USSR and ex-Czechoslovakia in 2000. The column "reliability rate" provides, for each sending country, the proportion of emigrants for which accurate information about education attainment has been collected (from the total number of individuals declared as emigrants from that country). In a large majority of cases, the reliability rate is higher than 90 percent. Changes between 1990 and 2000 are given in the last two columns, but only for countries showing a high reliability rate in 1990 and 2000 (the minimal threshold is set at 70 percent).

Table 2 - Emigration rates by educational attaiment and country of birth (1990-2000) (1/6)

	Situation in 1990					Situation in 2000					Brain drain change 2000/1990	
	Reliability rate	Migration rate - Primary education	Migration rate - Secondary education	Migration rate - Tertiary education	Migration rate - all education groups	*Reliability rate*	Migration rate - Primary education	Migration rate - Secondary education	Migration rate - Tertiary education	Migration rate - all education groups	Variation in percentage points (*)	Ratio (rate in 2000 / rate in 1990) (*)
AMERICA												
Northern America		**1.4%**	**0.6%**	**0.8%**	**0.8%**		**0.8%**	**0.6%**	**1.0%**	**0.8%**	**0.17%**	**1.21**
Canada	*98.0%*	3.7%	5.1%	4.8%	4.7%	*98.2%*	1.7%	5.0%	4.9%	4.3%	0.2%	1.03
United States	*85.2%*	1.0%	0.2%	0.4%	0.3%	*86.8%*	0.6%	0.2%	0.5%	0.4%	0.1%	1.28
Central America		**5.6%**	**10.4%**	**12.9%**	**7.3%**		**8.1%**	**15.6%**	**16.1%**	**11.0%**	**3.11%**	**1.24**
Belize	*99.9%*	5.0%	48.6%	62.6%	22.8%	*99.9%*	3.6%	49.2%	51.0%	18.4%	-11.6%	0.81
Costa Rica	*99.0%*	0.6%	7.5%	7.7%	2.6%	*99.3%*	0.8%	9.4%	6.6%	3.0%	-1.1%	0.86
El Salvador	*99.3%*	8.2%	38.5%	32.9%	14.4%	*99.4%*	11.2%	53.6%	31.5%	20.2%	-1.4%	0.96
Guatemala	*99.7%*	2.1%	18.9%	18.2%	4.3%	*99.9%*	3.5%	22.8%	21.5%	6.9%	3.2%	1.18
Honduras	*99.6%*	1.6%	13.2%	21.1%	4.0%	*99.8%*	3.2%	21.3%	21.8%	6.9%	0.7%	1.03
Mexico	*99.9%*	6.5%	8.9%	10.4%	7.4%	*99.9%*	9.5%	14.3%	14.3%	11.5%	3.9%	1.38
Nicaragua	*99.7%*	2.3%	23.9%	29.0%	7.7%	*99.8%*	2.5%	19.1%	30.9%	8.9%	1.9%	1.07
Panama	*99.6%*	1.1%	9.6%	21.7%	7.7%	*99.7%*	0.9%	8.7%	20.0%	7.5%	-1.8%	0.92
The Caribbean		**4.8%**	**17.6%**	**41.4%**	**11.6%**		**5.1%**	**17.8%**	**40.9%**	**13.9%**	**-0.53%**	**0.99**
Antigua and Barbuda	*99.8%*	7.0%	31.7%	65.3%	27.6%	*99.9%*	6.0%	35.9%	70.9%	36.7%	5.6%	1.09
Bahamas, The	*99.7%*	3.7%	11.7%	38.3%	11.0%	*99.8%*	1.5%	12.1%	36.4%	12.2%	-1.9%	0.95
Barbados	*99.8%*	14.1%	24.8%	63.5%	26.4%	*100.0%*	9.9%	24.3%	61.4%	27.8%	-2.1%	0.97
Cuba	*99.7%*	5.4%	11.9%	31.0%	10.5%	*99.1%*	5.5%	9.4%	28.9%	10.5%	-2.1%	0.93
Dominica	*97.7%*	16.6%	62.1%	58.9%	32.0%	*96.9%*	8.0%	60.6%	58.9%	32.1%	0.0%	1.00
Dominican Republic	*97.5%*	3.8%	23.6%	17.9%	7.9%	*98.1%*	5.8%	30.9%	21.7%	12.5%	3.8%	1.21
Grenada	*99.8%*	7.5%	61.1%	68.8%	30.5%	*100.0%*	9.9%	69.5%	66.7%	40.1%	-2.0%	0.97
Haiti	*99.9%*	2.1%	23.7%	78.3%	7.3%	*99.9%*	2.5%	27.5%	81.6%	10.2%	3.3%	1.04
Jamaica	*99.8%*	11.0%	28.9%	84.1%	25.6%	*100.0%*	8.3%	30.0%	82.5%	29.0%	-1.7%	0.98
Saint Kitts and Nevis	*99.7%*	10.8%	21.4%	89.9%	28.9%	*100.0%*	10.3%	37.1%	71.8%	38.5%	-18.0%	0.80
Saint Lucia	*99.7%*	1.9%	46.8%	80.4%	11.6%	*99.9%*	2.6%	32.1%	36.0%	14.0%	-44.4%	0.45
Saint Vincent and the Grenadines	*99.8%*	5.9%	56.7%	89.8%	22.4%	*99.9%*	6.3%	53.4%	56.8%	28.0%	-33.0%	0.63
Trinidad and Tobago	*99.7%*	5.7%	19.3%	77.2%	18.9%	*100.0%*	6.1%	20.6%	78.4%	23.7%	1.2%	1.02
South America		**0.2%**	**2.5%**	**4.7%**	**1.0%**		**0.4%**	**3.0%**	**5.7%**	**1.5%**	**1.03%**	**1.22**
Argentina	*94.8%*	0.3%	1.1%	3.3%	0.9%	*94.3%*	0.3%	1.1%	2.5%	0.9%	-0.8%	0.75
Bolivia	*95.4%*	0.1%	1.9%	5.9%	1.0%	*98.1%*	0.3%	4.6%	6.0%	1.8%	0.1%	1.01
Brazil	*62.5%*	0.1%	0.9%	1.7%	0.3%	*47.2%*	0.1%	1.5%	3.3%	0.6%	non reliab.	non reliab.
Chile	*82.5%*	0.6%	1.9%	6.3%	1.7%	*97.9%*	0.8%	1.8%	5.3%	1.9%	-1.0%	0.85
Colombia	*97.0%*	0.5%	3.9%	9.2%	1.8%	*98.2%*	0.8%	4.6%	11.0%	2.7%	1.8%	1.19
Ecuador	*98.0%*	0.8%	8.7%	5.4%	2.7%	*97.0%*	2.4%	10.6%	10.9%	5.6%	5.5%	2.02
Guyana	*98.8%*	10.9%	30.6%	89.2%	28.0%	*100.0%*	13.7%	34.1%	85.9%	34.5%	-3.3%	0.96
Paraguay	*96.8%*	0.2%	0.8%	3.2%	0.6%	*96.2%*	0.2%	0.7%	2.3%	0.5%	-0.8%	0.74

Table 2 - Emigration rates by educational attaiment and country of birth (1990-2000) (2/6)

Peru	*85.3%*	0.3%	2.6%	5.6%	1.6%	*77.8%*	0.7%	3.6%	6.3%	2.8%	0.7%	1.12
Suriname	*100.0%*	15.7%	54.0%	92.0%	42.1%	*100.0%*	17.5%	43.9%	89.9%	43.3%	-2.1%	0.98
Uruguay	*96.3%*	0.9%	2.5%	6.1%	1.9%	*97.6%*	1.1%	2.7%	8.6%	2.6%	2.5%	1.41
Venezuela	*96.9%*	0.2%	1.8%	3.9%	0.8%	*96.7%*	0.1%	2.4%	3.3%	0.9%	-0.6%	0.86
EUROPE												
Northern Europe		**6.3%**	**3.8%**	**16.2%**	**6.9%**		**5.4%**	**4.4%**	**14.3%**	**6.8%**	**-1.88%**	**0.88**
Denmark	*66.8%*	3.9%	2.1%	8.2%	3.9%	*96.9%*	5.2%	2.6%	7.0%	4.4%	non reliab.	non reliab.
Estonia	-	-	-	-	-	*99.5%*	3.4%	4.4%	13.9%	5.4%	-	-
Finland	*42.2%*	4.3%	2.4%	10.3%	4.4%	*99.1%*	8.8%	5.9%	8.4%	7.3%	non reliab.	non reliab.
Iceland	*64.0%*	4.2%	8.1%	28.8%	9.0%	*99.2%*	9.3%	7.7%	16.3%	9.8%	non reliab.	non reliab.
Ireland	*99.2%*	35.1%	18.2%	34.4%	28.5%	*99.5%*	18.2%	20.2%	34.4%	22.8%	0.0%	1.00
Latvia	-	-	-	-	-	*99.0%*	1.7%	2.0%	10.2%	3.0%	-	-
Lithuania	-	-	-	-	-	*99.7%*	7.3%	2.8%	11.8%	5.4%	-	-
Norway	*74.6%*	7.8%	1.8%	8.2%	3.8%	*98.1%*	9.0%	2.2%	5.4%	3.9%	-2.8%	0.66
Sweden	*77.9%*	1.7%	1.6%	5.0%	2.3%	*96.4%*	4.9%	1.3%	4.4%	2.8%	-0.6%	0.87
United Kingdom	*96.7%*	5.3%	3.7%	18.9%	6.9%	*98.6%*	4.5%	4.3%	16.7%	7.0%	-2.2%	0.88
Western Europe		**2.3%**	**2.4%**	**10.4%**	**3.4%**		**2.2%**	**2.3%**	**7.3%**	**3.2%**	**-3.15%**	**0.70**
Austria	*94.5%*	5.7%	4.4%	18.3%	6.2%	*97.2%*	6.0%	4.1%	11.1%	5.8%	-7.2%	0.60
Belgium	*81.6%*	2.0%	2.1%	7.0%	2.7%	*97.1%*	1.7%	2.9%	5.9%	2.9%	-1.1%	0.84
France	*88.8%*	1.1%	1.6%	5.1%	1.7%	*95.2%*	1.2%	1.6%	3.9%	1.9%	-1.2%	0.76
Germany	*84.1%*	2.6%	2.7%	14.3%	4.0%	*97.7%*	2.4%	2.4%	8.8%	3.6%	-5.5%	0.62
Liechtenstein	*88.9%*	8.3%	20.0%	27.7%	17.2%	*99.0%*	6.1%	15.9%	16.9%	13.3%	-10.8%	0.61
Luxembourg	*93.2%*	4.9%	5.8%	11.1%	6.1%	*98.0%*	4.1%	6.1%	7.6%	5.4%	-3.5%	0.69
Monaco	*98.3%*	5.2%	2.5%	13.2%	5.2%	*98.5%*	4.5%	6.5%	15.3%	7.4%	2.1%	1.16
Netherlands	*97.2%*	5.1%	2.6%	11.3%	5.1%	*99.8%*	5.0%	2.9%	8.9%	4.9%	-2.4%	0.79
Switzerland	*85.3%*	2.8%	1.7%	10.4%	3.3%	*92.4%*	2.0%	1.8%	9.1%	3.1%	-1.3%	0.88
Southern Europe		**5.8%**	**6.4%**	**11.2%**	**6.4%**		**5.5%**	**6.0%**	**9.0%**	**6.2%**	**-2.19%**	**0.80**
Albania	*84.2%*	0.5%	0.4%	1.6%	0.5%	*23.2%*	4.5%	9.0%	20.0%	8.1%	non reliab.	non reliab.
Andorra	-	-	-	-	-	*97.8%*	1.0%	1.0%	2.3%	1.2%	-	-
Bosnia and Herzegovina	-	-	-	-	-	*97.3%*	11.7%	17.0%	28.6%	15.9%	-	-
Croatia	-	-	-	-	-	*95.2%*	9.7%	10.3%	29.4%	12.4%	-	-
Greece	*96.3%*	8.2%	8.8%	18.9%	9.4%	*98.1%*	8.5%	7.8%	14.0%	9.1%	-4.9%	0.74
Italy	*98.8%*	5.2%	5.7%	9.9%	5.8%	*99.9%*	4.5%	4.9%	7.0%	5.0%	-2.8%	0.72
Macedonia	-	-	-	-	-	*88.1%*	12.7%	11.5%	20.9%	13.1%	-	-
Malta	*99.1%*	26.9%	14.4%	71.5%	27.7%	*98.8%*	25.6%	10.1%	55.2%	23.9%	-16.3%	0.77
Portugal	*98.8%*	13.1%	17.6%	14.6%	13.9%	*99.5%*	13.1%	20.5%	13.8%	14.3%	-0.8%	0.94
San Marino	*14.9%*	14.9%	18.1%	29.8%	17.5%	*11.7%*	9.1%	1.4%	29.9%	10.8%	non reliab.	non reliab.
Serbia and Montenegro	-	-	-	-	-	*87.3%*	6.1%	7.4%	17.4%	7.9%	-	-
Slovenia	-	-	-	-	-	*96.5%*	4.9%	4.1%	11.0%	5.5%	-	-
Spain	*95.2%*	1.8%	2.7%	3.4%	2.2%	*96.9%*	1.6%	1.8%	2.6%	1.8%	-0.8%	0.76
Ex-Yugoslavia	*90.5%*	13.5%	13.1%	32.3%	14.9%		*(8.3%)*	*(9.8%)*	*(21.5%)*	*(10.5%)*	-	-

Table 2 - Emigration rates by educational attaiment and country of birth (1990-2000) (3/6)

Eastern Europe		**1.4%**	**0.4%**	**2.3%**	**0.9%**		**2.3%**	**1.4%**	**4.5%**	**2.2%**	**2.16%**	**1.94**
Belarus	-	-	-	-	-	*99.2%*	3.1%	1.2%	3.0%	2.2%	-	-
Bulgaria	*96.4%*	7.0%	3.1%	2.7%	5.0%	*98.2%*	8.6%	6.0%	5.8%	7.1%	3.1%	2.13
Czech Republic	-	-	-	-	-	*97.7%*	4.2%	1.9%	9.9%	3.6%	-	-
Hungary	*88.7%*	1.7%	3.9%	13.5%	3.7%	*98.9%*	2.4%	3.7%	12.1%	4.1%	-1.3%	0.90
Moldova	-	-	-	-	-	*91.9%*	0.8%	0.7%	4.2%	1.1%	-	-
Poland	*92.8%*	3.1%	2.5%	12.8%	3.7%	*96.8%*	3.0%	3.1%	12.3%	4.1%	-0.5%	0.96
Romania	*51.1%*	1.9%	1.0%	11.1%	2.0%	*66.1%*	3.6%	1.7%	14.1%	3.5%	non reliab.	non reliab.
Russian Federation	-	-	-	-	-	*95.6%*	0.4%	0.3%	1.3%	0.6%	-	-
Slovakia	-	-	-	-	-	*90.5%*	10.0%	9.3%	15.3%	10.3%	-	-
Ukraine	-	-	-	-	-	*96.5%*	2.9%	1.0%	6.0%	2.2%	-	-
Ex-Czechoslovakia	*77.2%*	1.9%	1.3%	10.9%	2.4%		*(6.4%)*	*(4.3%)*	*(11.9%)*	*(6.0%)*	-	-
Ex-USSR	*31.1%*	0.6%	0.1%	0.8%	0.3%		*(1.1%)*	*(0.5%)*	*(2.4%)*	*(1.0%)*	-	-
AFRICA												
Northern Africa		**2.2%**	**1.8%**	**6.8%**	**2.4%**		**2.3%**	**1.5%**	**6.2%**	**2.5%**	**-0.62%**	**0.91**
Algeria	*98.4%*	4.5%	1.8%	6.7%	4.4%	*97.1%*	3.6%	1.3%	6.5%	3.3%	-0.2%	0.98
Egypt	*86.4%*	0.2%	1.0%	5.3%	0.7%	*84.0%*	0.2%	0.7%	4.2%	0.8%	-1.1%	0.80
Libya	*88.5%*	0.3%	1.7%	13.9%	0.9%	*90.6%*	0.4%	0.8%	3.8%	0.9%	-10.1%	0.27
Morocco	*90.8%*	6.1%	3.7%	9.3%	6.0%	*80.5%*	7.8%	3.8%	10.3%	7.1%	1.0%	1.11
Sudan	*86.4%*	0.0%	0.4%	5.0%	0.1%	*97.5%*	0.1%	0.7%	5.6%	0.2%	0.6%	1.13
Tunisia	*86.6%*	4.6%	3.4%	12.3%	4.7%	*71.1%*	4.2%	3.0%	9.6%	4.3%	-2.7%	0.78
Central Africa		**0.5%**	**1.0%**	**9.8%**	**0.6%**		**0.4%**	**1.3%**	**13.3%**	**0.8%**	**3.54%**	**1.36**
Angola	*97.7%*	2.8%	1.3%	7.1%	2.7%	*98.9%*	2.1%	3.4%	25.6%	2.7%	18.4%	3.59
Cameroon	*93.6%*	0.2%	1.1%	15.2%	0.4%	*92.2%*	0.2%	1.4%	14.6%	0.7%	-0.5%	0.97
Central African Republic	*96.8%*	0.1%	0.5%	4.4%	0.2%	*94.7%*	0.1%	0.5%	4.7%	0.2%	0.3%	1.06
Chad	*94.6%*	0.0%	1.0%	8.7%	0.1%	*94.7%*	0.0%	0.8%	6.9%	0.1%	-1.8%	0.80
Congo, Dem. Rep. of the	*89.3%*	0.1%	1.1%	8.3%	0.3%	*94.7%*	0.1%	0.5%	7.9%	0.3%	-0.4%	0.95
Congo, Rep. of the	*92.3%*	0.6%	0.6%	11.7%	1.1%	*94.9%*	1.4%	2.1%	19.1%	2.6%	7.4%	1.64
Equatorial Guinea	*82.1%*	0.1%	0.7%	4.3%	0.2%	*98.8%*	2.9%	6.4%	34.1%	4.1%	29.7%	7.84
Gabon	*94.0%*	0.2%	1.3%	21.2%	0.5%	*94.1%*	0.3%	1.1%	19.3%	0.8%	-1.9%	0.91
Sao Tome and Principe	*96.8%*	6.6%	0.7%	9.7%	6.2%	*98.6%*	4.0%	9.6%	35.6%	5.6%	25.9%	3.67
Western Africa		**0.3%**	**1.1%**	**20.7%**	**0.5%**		**0.3%**	**2.8%**	**26.7%**	**0.8%**	**6.04%**	**1.29**
Benin	*91.5%*	0.1%	0.4%	6.1%	0.2%	*85.5%*	0.1%	0.5%	7.5%	0.3%	1.4%	1.23
Burkina Faso	*70.0%*	0.1%	0.1%	2.6%	0.1%	*50.4%*	0.1%	0.4%	3.3%	0.2%	non reliab.	non reliab.
Cape Verde	*75.2%*	20.1%	55.9%	54.4%	23.8%	*90.3%*	14.7%	60.9%	69.1%	23.5%	14.6%	1.27
Cote d'Ivoire	*82.8%*	0.2%	1.2%	6.1%	0.3%	*75.1%*	0.3%	1.8%	7.8%	0.6%	1.7%	1.28
Gambia, The	*81.4%*	1.0%	0.9%	76.0%	1.3%	*97.1%*	1.7%	7.8%	64.7%	3.1%	-11.3%	0.85
Ghana	*76.4%*	0.8%	0.9%	33.7%	1.2%	*81.3%*	0.7%	2.2%	42.9%	1.9%	9.2%	1.27
Guinea	*92.2%*	0.2%	0.2%	5.1%	0.3%	*92.6%*	0.3%	0.4%	11.1%	0.5%	6.0%	2.18
Guinea-Bissau	*94.3%*	0.8%	0.6%	5.9%	0.8%	*97.3%*	1.3%	9.3%	29.4%	1.8%	23.5%	4.95
Liberia	*90.1%*	0.1%	2.2%	27.7%	1.1%	*99.3%*	0.4%	7.4%	37.4%	2.6%	9.7%	1.35

Table 2 - Emigration rates by educational attaiment and country of birth (1990-2000) (4/6)

Mali	*99.2%*	0.7%	0.6%	6.6%	0.7%	*98.6%*	0.6%	1.7%	11.5%	0.7%	4.9%	1.74
Mauritania	*91.9%*	0.6%	0.2%	3.5%	0.6%	*93.9%*	1.0%	3.9%	23.1%	1.4%	19.6%	6.56
Niger	*83.5%*	0.0%	0.6%	8.3%	0.1%	*73.8%*	0.0%	0.5%	6.1%	0.1%	-2.2%	0.74
Nigeria	*89.6%*	0.0%	1.6%	34.3%	0.2%	*88.8%*	0.1%	3.7%	36.1%	0.4%	1.8%	1.05
Senegal	*72.1%*	1.4%	2.2%	11.1%	1.6%	*56.5%*	1.7%	5.9%	24.1%	2.6%	non reliab.	non reliab.
Sierra Leone	*94.1%*	0.1%	1.9%	31.0%	0.5%	*97.5%*	0.3%	5.3%	41.0%	1.4%	10.0%	1.32
Togo	*90.3%*	0.3%	0.6%	8.9%	0.5%	*94.2%*	0.5%	2.3%	13.6%	1.0%	4.7%	1.53
Eastern Africa		**0.2%**	**1.0%**	**15.5%**	**0.4%**		**0.2%**	**1.6%**	**18.4%**	**0.6%**	**2.97%**	**1.19**
Burundi	*85.0%*	0.0%	1.0%	5.0%	0.1%	*91.0%*	0.1%	2.0%	19.9%	0.3%	14.9%	3.95
Comoros	*98.6%*	0.8%	1.4%	6.4%	1.0%	*100.0%*	1.9%	2.6%	14.5%	2.2%	8.0%	2.25
Djibouti	*87.6%*	0.2%	0.9%	9.4%	0.3%	*97.6%*	0.2%	1.3%	17.8%	0.5%	8.4%	1.90
Eritrea	-	-	-	-	-	*87.7%*	0.6%	12.8%	45.8%	2.3%	-	-
Ethiopia	*80.1%*	0.2%	1.1%	13.9%	0.4%	*93.2%*	0.1%	2.8%	17.0%	0.5%	3.2%	1.23
Kenya	*96.6%*	0.1%	0.8%	26.9%	0.5%	*98.8%*	0.1%	0.9%	26.3%	0.7%	-0.7%	0.98
Madagascar	*96.2%*	0.1%	3.1%	55.2%	0.2%	*93.8%*	0.1%	1.8%	36.0%	0.2%	-19.1%	0.65
Malawi	*95.7%*	0.0%	0.3%	7.5%	0.1%	*99.3%*	0.0%	0.8%	9.4%	0.1%	1.9%	1.25
Mauritius	*91.2%*	3.8%	4.3%	37.2%	5.3%	*81.8%*	5.3%	5.0%	48.0%	7.2%	10.8%	1.29
Mozambique	*99.3%*	0.8%	1.1%	18.2%	0.8%	*99.6%*	0.5%	5.8%	42.0%	0.9%	23.8%	2.31
Rwanda	*87.7%*	0.0%	1.7%	9.4%	0.1%	*93.1%*	0.0%	2.1%	19.0%	0.2%	9.6%	2.02
Seychelles	*92.5%*	11.4%	10.8%	48.9%	14.2%	*100.0%*	9.7%	10.0%	58.6%	14.6%	9.7%	1.20
Somalia	*92.5%*	11.4%	10.8%	48.9%	14.2%	*100.0%*	9.7%	10.0%	58.6%	14.6%	9.7%	1.20
Tanzania	*96.8%*	0.1%	0.8%	14.8%	0.3%	*98.4%*	0.1%	1.0%	15.8%	0.3%	1.0%	1.07
Uganda	*95.6%*	0.1%	0.4%	29.9%	0.4%	*98.9%*	0.1%	1.2%	21.6%	0.5%	-8.3%	0.72
Zambia	*92.5%*	0.0%	0.3%	12.2%	0.2%	*98.5%*	0.1%	0.3%	10.0%	0.3%	-2.2%	0.82
Zimbabwe	*97.3%*	0.1%	0.4%	5.1%	0.5%	*99.7%*	0.2%	0.7%	7.6%	0.8%	2.5%	1.50
Southern Africa		**0.1%**	**0.5%**	**6.9%**	**0.5%**		**0.3%**	**0.5%**	**5.3%**	**0.9%**	**-1.57%**	**0.77**
Botswana	*86.2%*	0.0%	0.1%	1.7%	0.1%	*98.2%*	0.1%	0.8%	2.1%	0.3%	0.3%	1.20
Lesotho	*92.5%*	0.0%	0.1%	6.2%	0.1%	*98.0%*	0.0%	0.1%	2.4%	0.0%	-3.9%	0.38
Namibia	*87.9%*	0.0%	0.1%	2.9%	0.2%	*99.1%*	0.1%	0.2%	3.4%	0.3%	0.5%	1.18
South Africa	*96.2%*	0.2%	0.5%	7.2%	0.5%	*99.7%*	0.4%	0.5%	5.4%	1.0%	-1.8%	0.75
Swaziland	*60.0%*	0.1%	0.3%	3.6%	0.3%	*99.6%*	0.2%	0.2%	5.8%	0.5%	non reliab.	non reliab.
ASIA												
Western Asia		**2.6%**	**4.7%**	**6.9%**	**3.3%**		**2.8%**	**2.9%**	**5.8%**	**3.2%**	**-1.10%**	**0.84**
Armenia	-	-	-	-	-	*99.4%*	1.3%	1.8%	11.2%	2.9%	-	-
Azerbaijan	-	-	-	-	-	*99.5%*	0.5%	0.2%	2.6%	0.6%	-	-
Bahrain	*95.8%*	0.1%	0.4%	3.3%	0.5%	*100.0%*	0.1%	0.6%	3.4%	0.7%	0.1%	1.04
Cyprus	*99.1%*	11.9%	9.0%	21.1%	12.7%	*99.4%*	11.8%	4.0%	17.9%	9.9%	-3.2%	0.85
Georgia	-	-	-	-	-	*97.8%*	0.3%	0.2%	2.6%	0.5%	-	-
Iraq	*84.3%*	0.6%	2.2%	7.3%	1.3%	*99.3%*	1.9%	4.0%	9.1%	2.9%	1.8%	1.24
Israel / Palestine	*96.6%*	1.5%	3.4%	7.7%	3.6%	*98.1%*	1.5%	2.5%	6.5%	3.2%	-1.2%	0.84
Jordan	*93.9%*	1.0%	4.1%	6.0%	2.5%	*94.8%*	0.8%	2.2%	6.4%	2.5%	0.4%	1.06

Table 2 - Emigration rates by educational attaiment and country of birth (1990-2000) (5/6)

Kuwait	*88.1%*	0.1%	0.2%	3.0%	0.5%	*99.4%*	0.5%	1.0%	10.0%	2.3%	7.0%	3.37
Lebanon	*96.3%*	6.4%	21.4%	35.6%	12.6%	*98.7%*	9.5%	13.1%	29.7%	13.5%	-5.9%	0.83
Oman	*75.8%*	0.0%	0.0%	0.3%	0.0%	*97.8%*	0.0%	0.0%	0.5%	0.1%	0.1%	1.43
Qatar	*96.1%*	0.0%	0.1%	2.1%	0.3%	*98.9%*	0.1%	0.1%	2.9%	0.5%	0.8%	1.38
Saudi Arabia	*92.8%*	0.1%	0.1%	0.7%	0.2%	*99.1%*	0.0%	0.1%	0.7%	0.1%	0.0%	1.01
Syria	*90.2%*	0.7%	3.2%	6.9%	1.7%	*97.0%*	0.7%	2.6%	5.2%	1.7%	-1.6%	0.76
Turkey	*89.4%*	4.2%	9.3%	6.3%	4.9%	*99.6%*	4.6%	7.5%	4.6%	5.0%	-1.6%	0.74
United Arab Emirates	*84.1%*	0.1%	0.1%	0.5%	0.1%	*98.5%*	0.1%	0.1%	1.2%	0.2%	0.7%	2.35
Yemen	*94.2%*	0.0%	0.8%	3.3%	0.1%	*98.6%*	0.1%	1.5%	5.7%	0.2%	2.3%	1.70
South-Central Asia		**0.1%**	**0.4%**	**4.0%**	**0.3%**		**0.1%**	**0.5%**	**5.1%**	**0.5%**	**1.09%**	**1.27**
Afghanistan	*92.9%*	0.2%	8.8%	11.7%	0.8%	*99.6%*	0.5%	6.6%	13.2%	1.0%	1.5%	1.13
Bangladesh	*84.9%*	0.1%	0.2%	2.3%	0.1%	*81.9%*	0.1%	0.7%	4.7%	0.3%	2.4%	2.02
Bhutan	*82.0%*	0.0%	0.1%	1.7%	0.0%	*96.7%*	0.1%	0.3%	1.2%	0.1%	-0.4%	0.73
India	*96.6%*	0.1%	0.2%	2.6%	0.2%	*97.3%*	0.1%	0.3%	4.2%	0.3%	1.6%	1.61
Iran	*85.7%*	0.3%	2.2%	23.7%	1.5%	*97.2%*	0.6%	2.0%	13.1%	1.8%	-10.6%	0.55
Kazakhstan	-	-	-	-	-	*98.7%*	0.5%	0.2%	1.1%	0.5%	-	-
Kyrgyzstan	-	-	-	-	-	*98.5%*	0.5%	0.1%	0.7%	0.3%	-	-
Maldives	*90.8%*	0.0%	0.1%	2.3%	0.1%	*92.9%*	0.1%	0.1%	2.2%	0.2%	0.0%	0.99
Nepal	*93.3%*	0.0%	0.1%	1.9%	0.0%	*98.7%*	0.0%	0.2%	2.7%	0.1%	0.8%	1.43
Pakistan	*85.9%*	0.2%	0.6%	6.1%	0.4%	*93.7%*	0.3%	1.1%	9.2%	0.7%	3.1%	1.51
Sri Lanka	*85.9%*	0.8%	1.5%	24.8%	1.6%	*85.8%*	1.9%	1.8%	27.5%	2.8%	2.7%	1.11
Tajikistan	-	-	-	-	-	*99.3%*	0.2%	0.1%	0.7%	0.2%	-	-
Turkmenistan	-	-	-	-	-	*97.2%*	0.1%	0.0%	0.1%	0.1%	-	-
Uzbekistan	-	-	-	-	-	*81.5%*	0.2%	0.1%	1.0%	0.2%	-	-
South-Eastern Asia		**0.4%**	**1.9%**	**10.3%**	**1.2%**		**0.5%**	**2.1%**	**9.8%**	**1.7%**	**-0.47%**	**0.95**
Brunei	*96.9%*	1.0%	2.4%	44.6%	3.5%	*100.0%*	1.3%	1.3%	21.0%	3.1%	-23.6%	0.47
Burma (Myanmar)	*99.6%*	0.0%	0.3%	3.3%	0.1%	*99.8%*	0.0%	0.3%	3.4%	0.2%	0.2%	1.05
Cambodia	*98.5%*	2.2%	7.6%	6.6%	3.0%	*98.9%*	1.8%	8.6%	6.8%	3.1%	0.2%	1.03
Indonesia	*35.3%*	0.1%	0.4%	6.2%	0.3%	*84.1%*	0.1%	0.3%	2.0%	0.2%	non reliab.	non reliab.
Laos	*99.9%*	4.5%	18.1%	14.9%	6.7%	*99.9%*	4.1%	20.9%	13.8%	7.1%	-1.0%	0.93
Malaysia	*93.4%*	0.4%	1.1%	21.5%	1.3%	*94.4%*	0.6%	0.8%	10.4%	1.5%	-11.1%	0.48
Philippines	*91.9%*	1.1%	3.1%	12.8%	4.1%	*87.0%*	1.4%	3.1%	14.8%	5.2%	2.0%	1.16
Singapore	*96.1%*	0.8%	1.6%	20.6%	2.2%	*96.6%*	1.4%	1.6%	15.2%	3.1%	-5.4%	0.74
Thailand	*86.5%*	0.1%	1.5%	2.4%	0.4%	*84.2%*	0.3%	1.4%	2.2%	0.7%	-0.2%	0.90
Vietnam	*94.7%*	0.8%	6.3%	21.7%	2.1%	*97.1%*	1.5%	12.3%	39.0%	4.3%	17.3%	1.79
Eastern Asia		**0.1%**	**0.3%**	**4.1%**	**0.4%**		**0.2%**	**0.3%**	**4.3%**	**0.5%**	**0.21%**	**1.05**
China	*79.4%*	0.1%	0.1%	3.1%	0.2%	*75.6%*	0.1%	0.2%	4.2%	0.2%	1.2%	1.38
Hong Kong	*99.2%*	2.2%	3.2%	29.7%	6.5%	*100.0%*	4.2%	4.1%	28.7%	8.9%	-1.0%	0.97
Macao	*99.9%*	1.4%	2.4%	20.5%	4.3%	*99.9%*	9.9%	7.0%	22.6%	10.8%	2.0%	1.10
Japan	*95.7%*	0.1%	0.3%	1.3%	0.4%	*95.9%*	0.2%	0.3%	1.5%	0.6%	0.2%	1.20
Korea, North	*98.3%*	0.0%	0.0%	0.2%	0.0%	*100.0%*	0.6%	1.4%	5.3%	2.2%	5.2%	35.58
Korea, South	*40.0%*	1.4%	3.7%	20.2%	4.8%	*19.2%*	2.0%	1.3%	7.9%	2.6%	non reliab.	non reliab.

Table 2 - Emigration rates by educational attaiment and country of birth (1990-2000) (6/6)

Mongolia	*20.3%*	0.0%	0.1%	1.1%	0.1%	*92.0%*	0.1%	0.3%	7.8%	0.4%	non reliab.	non reliab.
Taiwan	*89.5%*	0.2%	0.9%	11.4%	2.0%	*93.4%*	0.3%	1.0%	9.6%	2.5%	-1.8%	0.84
OCEANIA												
Oceania		**3.5%**	**1.7%**	**6.1%**	**3.3%**		**3.3%**	**3.4%**	**6.6%**	**4.3%**	**0.60%**	**1.10**
Australia	*91.0%*	1.7%	0.5%	2.8%	1.4%	*94.3%*	1.5%	1.4%	2.3%	1.7%	-0.5%	0.84
Fiji	*99.9%*	9.1%	12.6%	63.6%	15.5%	*100.0%*	10.7%	17.6%	58.7%	19.7%	-4.9%	0.92
Kiribati	*99.6%*	2.3%	3.2%	26.8%	3.9%	*100.0%*	2.5%	4.3%	24.9%	5.1%	-1.9%	0.93
Marshall Islands	*99.2%*	0.6%	4.5%	27.7%	3.4%	*100.0%*	0.1%	17.7%	41.0%	11.1%	13.4%	1.48
Micronesia, Federated States of	*100.0%*	0.3%	2.4%	27.1%	2.5%	*100.0%*	3.1%	10.8%	36.4%	9.2%	9.3%	1.34
New Zealand	*98.7%*	10.7%	8.5%	10.2%	10.0%	*98.9%*	11.3%	9.6%	15.0%	12.4%	4.8%	1.47
Palau	*100.0%*	2.1%	6.1%	62.6%	9.5%	*100.0%*	4.2%	19.6%	30.0%	12.3%	-32.5%	0.48
Papua New Guinea	*99.4%*	0.3%	3.8%	35.2%	0.8%	*99.9%*	0.3%	3.0%	28.2%	1.0%	-6.9%	0.80
Samoa	*99.8%*	37.4%	9.6%	75.9%	35.3%	*99.9%*	34.4%	47.2%	66.6%	43.1%	-9.3%	0.88
Solomon Islands	*98.4%*	0.2%	0.3%	6.2%	0.5%	*99.6%*	0.4%	0.4%	3.7%	0.6%	-2.6%	0.59
Tonga	*99.9%*	25.6%	30.6%	77.0%	33.4%	*100.0%*	29.4%	50.8%	74.2%	44.6%	-2.8%	0.96
Vanuatu	*99.4%*	0.5%	0.8%	9.4%	1.0%	*99.6%*	1.0%	0.7%	5.0%	1.2%	-4.4%	0.53

Note (*): "non reliab." means that at least one observation is based on less than 70 percent of information

3.1 Gross results

Our results indicate that skilled workers are much more concerned by international migration. At the world level in 1990, high-skill immigrants represented 33 percent of the OECD immigration stock whilst only 9.1 percent of the world labor force was tertiary educated. Between 1990 and 2000, the percentage of skilled immigrants increased to 37 percent. The proportions are more impressive for Africa and Asia where the skill structure of emigration is much higher than the skill structure of the domestic labor supply:

- 23.0 percent of African immigrants were tertiary educated in 1990 (31.4 percent in 2000) whilst the proportion of highly skilled workers in African countries was 2.2 percent (3.6 percent in 2000);
- 43.5 percent of Asian immigrants were tertiary educated in 1990 (47.2 percent in 2000) whilst the proportion of highly skilled workers in Asian countries was 4.7 percent (6.0 percent in 2000);
- 27.6 percent of Latin American immigrants (including Central America and the Caribbean) were tertiary educated in 1990 (28.1 percent in 2000) whilst the proportion of highly skilled workers in Latin American countries was 8.9 percent (11.8 percent in 2000).

The same conclusion holds in terms of emigration rates by educational attainment. As shown in figure 1, although there is a close relationship between these two rates, the emigration rate of skilled workers is higher than the total emigration rate in all countries. In 2000, the world-wide average emigration rate of skilled workers was 5.47 percent, 3.3 times larger than the average emigration rate of all workers (1.66%) and 5.8 times larger than the emigration of unskilled workers. By disregarding illegal migration, we obviously underestimate global and unskilled migration rates.

The emigration of skilled workers is particularly high in some parts of the world. Figure 2 gives a world map representation of the emigration rate of skilled workers. the darker the areas, the more affected it is by the brain drain. Clearly, Central America (including the Caribbean), South Eastern Asian countries and a chain of countries in Western and Eastern Africa experience a tremendous outflow of their skilled labor force to the OECD.

The brain drain increased between 1990 and 2000. The world-wide average emigration rate of skilled workers increased by .75 percentage points over that period, against .41 for medium skilled workers and .06 for the low skilled. With Mexico (+3.2 points) and Guatemala (+3.9 points), Central America is more and more affected by the migration of skilled workers. However, it is in Western, Eastern and Central Africa that the brain drain increased the most severely. Countries experiencing the largest increases are Angola (+18.4 points), Equatorial Guinea (+29.7 points), Ghana (+9.2 points), Sao Tome and Principe (+25.9 points), Guinea-Bissau (+23.5 points),

Liberia (+9.7 points), Mauritania (+19.6 points), Sierra Leone (+10.0 points), Burundi (+14.9 points), Mauritius (+10.8 points), Mozambique (+23.8 points), Rwanda (+9.6 points) and Somalia (+19.7 points).

Regarding Asia, the average migration rate of skilled workers decreased in Western Asia but increased slightly in South-Central Asia. Remarkable changes are observed in large countries such as Iran (-10.6 points), Malaysia (-11.1 points), Brunei (-23.6 points) and, in the other direction, Vietnam (+17.3 points).

It is worth noticing that North-North brain drain did decrease over the last 10 years (except in a few countries where the changes were very small). The average migration rate of tertiary educated workers decreased by 3.15 points in Western Europe, by 2.19 points in Southern Europe and by 1.88 points in Northern Europe. It improved significantly in Austria (-7.2 points), Germany (-5.5 points), Greece (-4.9 points), Italy (-2.8 points) and Malta (-16.3 points).

Figure 1. Skilled migration rate and total emigration rate in 2000

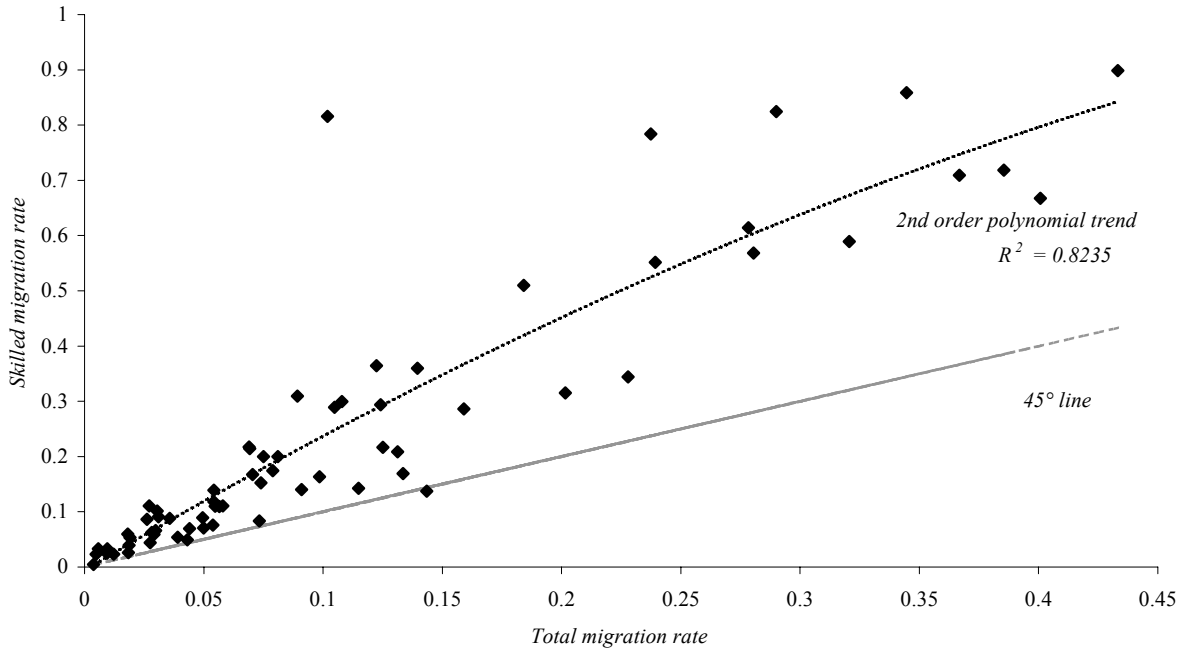
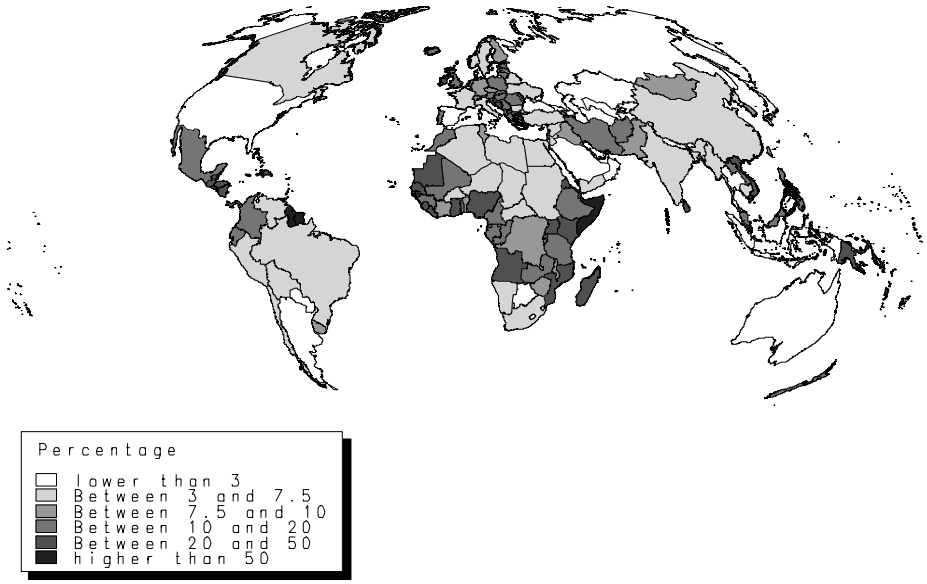


Figure 2. Skilled emigration in 2000 - World map



3.2 Comparison with previous study

Carrington and Detragiache's study clearly initiated new debates on the size and the distribution of the brain drain. Our purpose is to refine their method by incorporating additional statistical sources. By collecting Census, Register and Survey data from all OECD countries, we eliminate two sources of bias:

- Relying on OECD statistics on immigration brings on several problems. First, in 1990, these data only provided information on the country of origin for the top-10 or top-5 sending countries. Hence, small sending countries are usually not identified, at least in the majority of receiving countries. Second, immigration in EU countries is based on the concept of citizenship rather than on country of birth. Third, immigration data are missing for a few OECD countries (Greece, Iceland, Mexico, Slovakia, Turkey). Finally, the OECD provides data on the total immigration stock rather than on the adult immigration stock (which can be compared with the labor force in sending countries). Compared to national Censuses, we estimate that relying on OECD statistics implies an average underestimation in skilled workers migration rates by 11.3% in 1990 and 10.6% in 2000. This is the major source of bias, especially for small sized countries which are usually not identified as important sending countries;

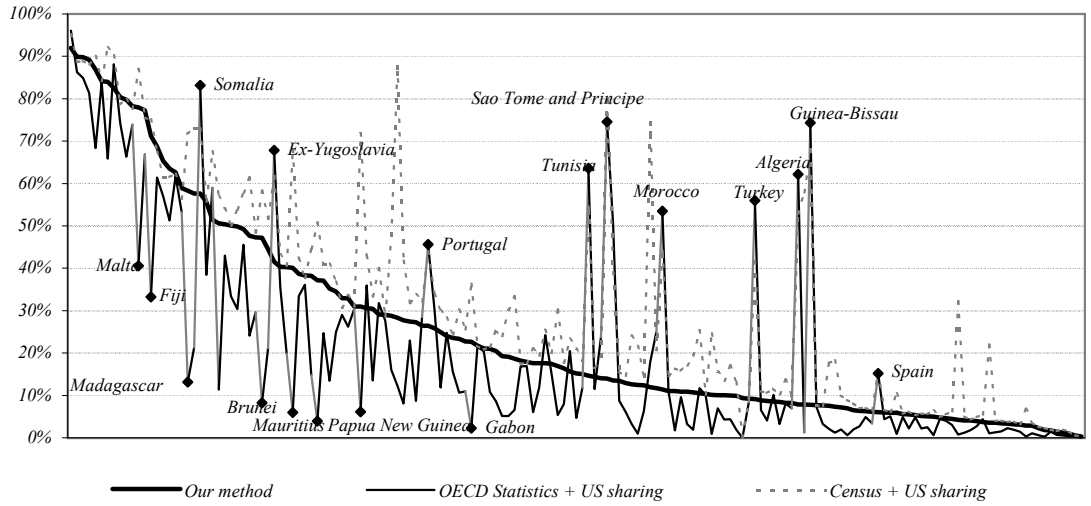
- Transposing the US educational structure on other OECD countries induces an average overestimation in skilled workers migration rates by 7.25% in 1990 and 6.22% in 2000. The bias is obviously strong in countries sending a minor part of their emigrants to the US.

On average, Carrington and Detragiache's method underestimates the emigration rates of skilled workers by 4% in 1990 and 4.4% in 2000. This appears in figure 3 (fig 3.A and 3.B) which gives skilled migration rates evaluated under three measurement methods: (i) a method fully based on Censuses and administrative data (our method), (ii) a method based on OECD statistics and US educational attainment data (Carrington and Detragriache), (iii) an intermediate method based on Census/administrative data and US educational attainment data. In comparison to the Census method, the second method clearly underestimates the brain drain for a large majority of countries. On the contrary, the third method overestimates the brain drain.

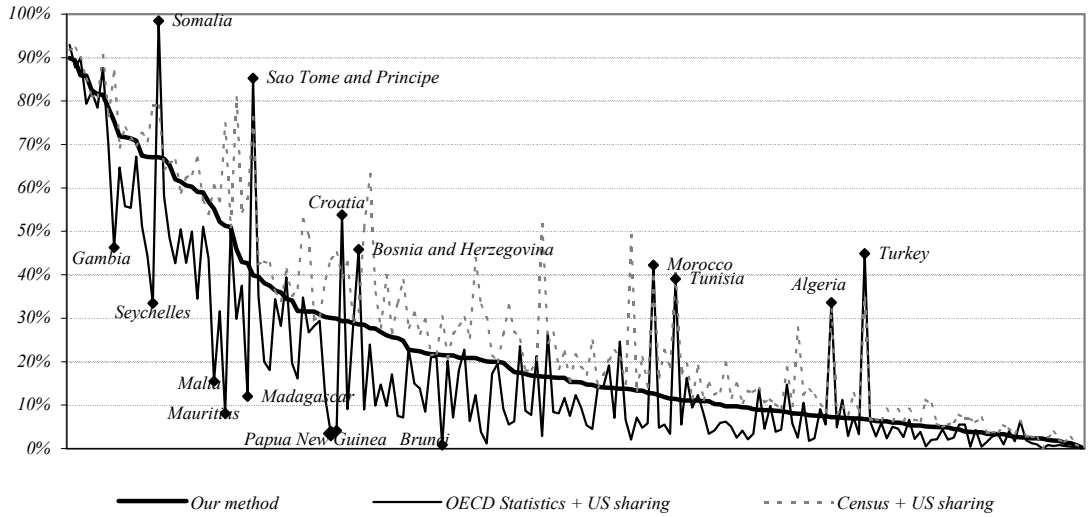
The two sources of bias cancel each other in a couple of cases. However, the brain drain is particularly overestimated in countries such as Algeria, Tunisia, Morocco, Turkey, Somalia. By transposing the educational structure observed in the US, Carrington and Detragiache and Adams obtain high emigration rates of tertiary education workers for these countries (between 55 and 65 percent for North Africa and Turkey). Taking into account the low level of education observed among emigrants to Europe (where the large majority of these migrants live), we obtain much lower skilled emigration rates (between 5 and 10 percent).

Figure 3. Comparison with alternative methods

A. Emigration rates under 3 measurement methods (1990)

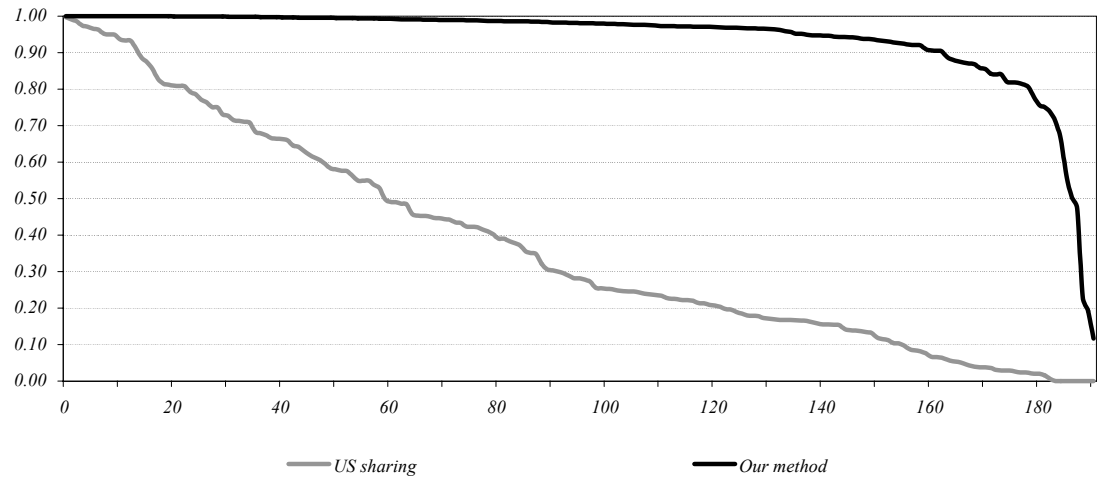


B. Emigration rates under 3 measurement methods (2000)



C. Number of reliable obs. and reliability rate* - US sharing vs Census sharing

(*) % of emigrants for which educational attainment is observed



On the contrary, the brain drain is strongly underestimated in countries such as the Gambia, Madagascar, Gabon, Brunei, Papua New Guinea. These countries send a relatively small number of emigrants to non-US areas. They are usually not identified in the OECD migration statistics. Consequently, their emigration rates are largely underestimated.

The last figure (fig 3.C) represents the percentage of emigrants on the basis of which educational attainment is extrapolated (let us call this proportion a "reliability rate"). On average, our method is based on 92.7 percent of observations. A method relying on US educational attainment is based on 44.1 percent of observations. However, the reliability rate is heterogenous bewteen countries. Figure 3.C represents the number of reliable country estimates as a function of the reliability criterion required by any user of the database. The function is obviously decreasing: the number of reliable observations decreases with the degree of reliability imposed by the user. For example, setting the reliability rate at 80 percent, our database provides 175 reliable country observations in 2000 (160 reliable observations in 2000). Transposing the US immigration structure to the total stock of immigrants, we would only provide 23 reliable observations in 2000 (22 countries in 1990) at the same reliability rate. By extending the number of observations and their degree of reliability, our method provides useful material to examine the changes in the international distribution of migration rates, to test for the (push and pull) determinants of migration per skill group or to evaluate the macroeconomic consequences of migration on source and destination countries.

4 Key indicators

Let us summarize the results by a few figures.

Immigration structure in OECD areas. The intensity of the brain drain clearly depends on the structure of immigration in OECD countries. Figure 4 describes that structure. In figure 4.A, it clearly appears that the US is the major destination country for skilled workers. The proportion of OECD educated migrants residing in the US increased from 48 percent to 53 percent between 1990 and 2000. The European Union is the second destination, attracting 16.3 percent of the educated in 2000 and 15.2 in 1990 (the migration between European countries is counted), just above Canada (13.9 percent in 2000 and 15.7 in 1990). Figure 4.B shows that the proportion of skilled immigrants in the total immigration stock is very high in Canada (58 percent). It is lower in Australia (46 percent) and the US (44%), and quite low in the European Union (22 percent). Such disparities are due to the historical composition of immigration flows over the last decades. Focusing on the variation between 1990 and 2000 (capturing recent immigration policies), it appears that the rise in educational attainment of immigrants has been very strong in Australia and, to a lesser extent, in Canada, compared to the US and Europe. These trends are compatible with the stylized facts and policy measures presented in the introduction.

Antecol et al (2003) also confirm our results by comparing the composition the stock of immigrants who arrived after 1985 in the US, Canada and Australia. Finally, figure 4.C shows that the low-income countries have been strongly affected by the recent brain drain. In all OECD areas, the percentage of skilled immigrants coming from low-income countries (such as India, China, Vietnam, Pakistan, Indonesia) increased between 1990 and 2000. This is especially the case in North America.

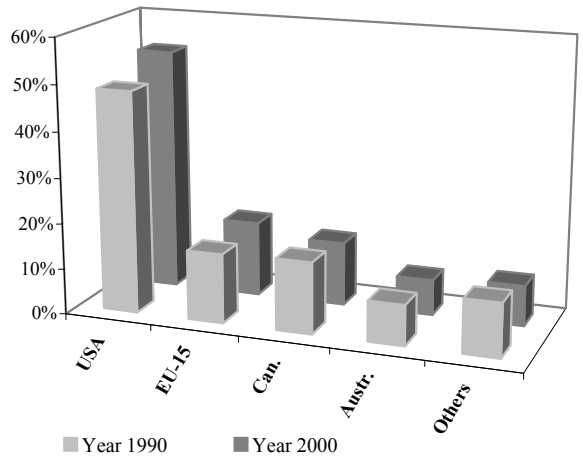
Who is suffering from the brain drain? Table 3 gives the 30 most affected countries in 2000. Of course, the intensity of brain drain differs if it is measured in absolute or relative terms. In absolute terms (number of educated emigrants), the largest countries are obviously strongly affected by the brain drain. The stock of skilled emigrants is high in the Philippines, India, China, Mexico and Vietnam but also in developed countries such as the UK and Germany, Canada or Italy. In relative terms (as a proportion of the educated labor force), small countries with a population below 4 million are the most affected. The emigration rate exceeds 80 percent in nations such as Suriname, Guyana, Haiti and Jamaica. One could argue that the distance from the US is a key element explaining the high emigration rates from these countries. Nevertheless, we believe that reality is much more complex. First, a simple regression of emigration rates on distances (in logs) to the closest OECD country reveals that distance cannot explain country differences (the slope is not signicantly different from zero for the subset of small countries with population below 4 million[12]). Second, although being close to the US, countries such as Suriname send most of their migrants to other countries (the Netherlands): historical, cultural, linguistic and colonial ties are potentially important. Formal tests would be required to assess the role of push and pull factors in the international mobility of skilled workers.

Excluding small sized countries (population below 4 million), column 3 stresses the importance of the brain drain in Africa and Central America. On the Western and Eastern coasts of Africa, tremendous rates of emigration are found in nations such as Somalia, Ghana, Mozambique, Sierra Leone, Nigeria or Madagascar. In Asia, Vietnam and Lebanon are the most affected. Regarding Europe, emigration rates are particularly strong in two countries of ex-Yugoslavia (Croatia and Serbia) and in the United Kingdom. The last column in table 3 reveals that countries from the ex-USSR, South America and the Arab Gulf exhibit very small rates (as well as in Japan, France and the United States). Finally, it is worth noticing that developing countries with large stocks of skilled emigrants may exhibit low rates of emigration. This is obviously the case of India, China and Brazil.

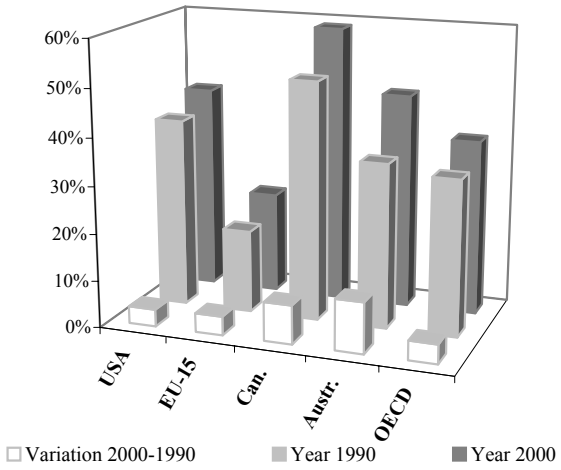
[12]Note that with the full sample, the relationship becomes significant. The skilled emigration rate can be explained by a log-linear equation $EMR_i = 1.7133 - 0.1676 \times Log(MinDist_i)$ with an R^2 of 16.21.

Figure 4. Skilled immigration in OECD areas

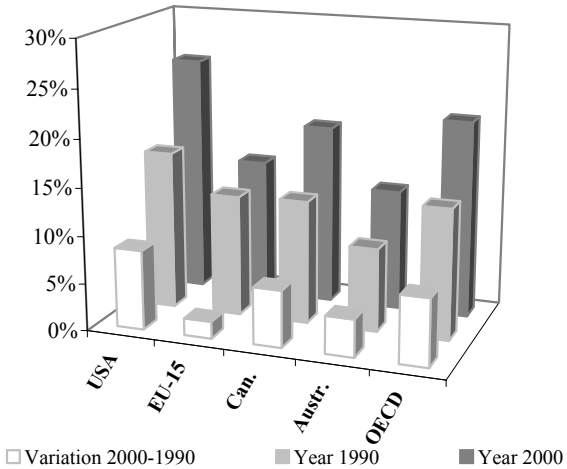
A. Destination of skilled immigrants in percent of the OECD



B. Skilled immigrants in percent of the immigration stock



C. Percentage of skilled immigrants from low income countries



The world distribution of the brain drain. It is interesting to compute average migration rates by region, income group (the World Bank classification distinguishes four categories) and size groups (above 25 million, between 10 and 25 million, between 4 and 10 million and below 4 million). It comes out that the distribution of emigration rates is strongly heterogenous within groups. For example, the disparities between the Caribbean countries and the US are tremendously high in America; large differences are observed between high-income countries such as Malta, Ireland, Hong-Kong and, on the other hand, Australia, Japan or the USA. However, as shown in figure 5, disparities in the average rates reveal interesting results.

Regarding the regional distribution (see figure 5.A), the most affected continents are Africa and Europe. Oceania and Asia exhibit intermediate rates whilst the average American brain drain is small. The regional disparities are extremely stable between 1990 and 2000. As for income groups (see figure 5.B), it is worth noticing that the highest rates are observed in middle income countries. High income countries (less incentives to emigrate) and low-income countries (where liquidity constraint are likely to be more binding) exhibit the lowest rates. As reported in Schiff (1996), liquidity constraints in poor and unequal societies explain the increasing relationship between income and migration at low income levels. Papers by Freeman (1993), Faini and Venturini (1993), Funkhouser (1995), World Bank (1994) have shown that emigrants essentially do not come from low income group. It is worth noticing that between 1990 and 2000, the situation clearly improved in lower-middle income countries and deteriorated in low-income countries.

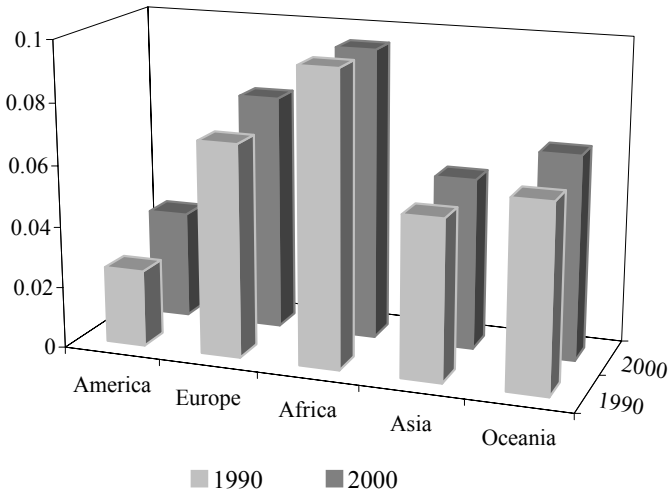
Finally, regarding size groups, we obtain a decreasing relationship between emigration rates and country population sizes. Disparities are also extremely stable over time. Our key indicators suggest that country size, GDP per capita, inequality and poverty rates are important determinants of emigration. Obviously, formal tests would be required to assess the relative effect of selection, network effects, economic, cultural, historical or political determinants of emigration. Whether these factors play differently across skill groups is a crucial issue.

Table 3. Emigration (stocks or rates) of skilled workers in selected countries

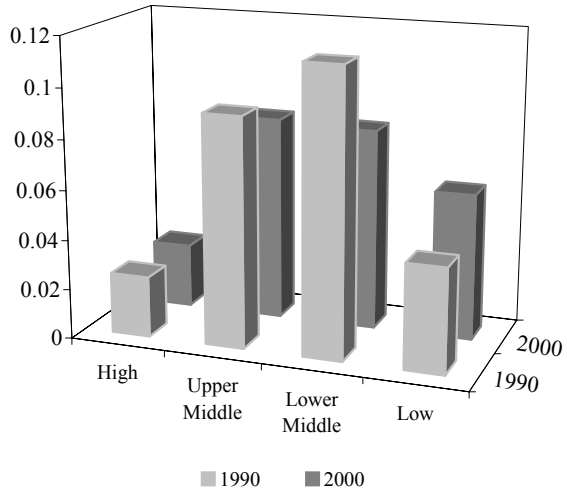
	Emigration stock in 2000 *30 largest stocks*		**Emigration rate in 2000** *30 highest rates*		**Idem with Pop. > 4 millions** *30 highest rates*		**Emigration rate in 2000** *30 lowest rates*		**Idem with Pop. > 4 millions** *30 lowest rates*	
1	United Kingdom	1 542 011	*Suriname*	*89.9%*	Haiti	81.6%	*Venezuela*	*3.3%*	Sweden	4.4%
2	Philippines	1 260 879	*Guyana*	*85.9%*	Somalia	58.6%	*Brazil*	*3.3%*	Egypt	4.2%
3	India	1 021 613	*Jamaica*	*82.5%*	Ghana	42.9%	*Burkina Faso*	*3.3%*	China	4.2%
4	Germany	1 016 007	*Haiti*	*81.6%*	Mozambique	42.0%	*Belarus*	*3.0%*	India	4.2%
5	China	906 337	*Trinidad and Tobago*	*78.4%*	Sierra Leone	41.0%	*Qatar*	*2.9%*	Moldova	4.2%
6	Mexico	901 347	*Tonga*	*74.2%*	Vietnam	39.0%	*Nepal*	*2.7%*	France	3.9%
7	Canada	566 833	*Saint Kitts and Nevis*	*71.8%*	Nigeria	36.1%	*Georgia*	*2.6%*	Libya	3.8%
8	Italy	470 331	*Antigua and Barbuda*	*70.9%*	Madagascar	36.0%	*Azerbaijan*	*2.6%*	Burma (Myanmar)	3.4%
9	Vietnam	446 895	*Cape Verde*	*69.1%*	El Salvador	31.5%	*Spain*	*2.6%*	Venezuela	3.3%
10	United States	428 078	*Grenada*	*66.7%*	Nicaragua	30.9%	*Argentina*	*2.5%*	Brazil	3.3%
11	Korea, North	422 518	*Samoa*	*66.6%*	Lebanon	29.7%	*Lesotho*	*2.4%*	Burkina Faso	3.3%
12	Korea, South	384 497	*Gambia, The*	*64.7%*	Croatia	29.4%	*Australia*	*2.3%*	Belarus	3.0%
13	Poland	379 266	*Barbados*	*61.4%*	Cuba	28.9%	*Paraguay*	*2.3%*	Nepal	2.7%
14	Cuba	336 419	*Dominica*	*58.9%*	Hong Kong	28.7%	*Andorra*	*2.3%*	Georgia	2.6%
15	Japan	331 892	*Fiji*	*58.7%*	Papua New Guinea	28.2%	*Maldives*	*2.2%*	Azerbaijan	2.6%
16	France	301 717	*Seychelles*	*58.6%*	Sri Lanka	27.5%	*Thailand*	*2.2%*	Spain	2.6%
17	Iran	282 587	*Somalia*	*58.6%*	Kenya	26.3%	*Botswana*	*2.1%*	Argentina	2.5%
18	Taiwan	280 710	*Saint Vincent & Gren.*	*56.8%*	Angola	25.6%	*Indonesia*	*2.0%*	Australia	2.3%
19	Russian Federation	263 041	*Malta*	*55.2%*	Senegal	24.1%	*Japan*	*1.5%*	Paraguay	2.3%
20	Jamaica	260 850	*Belize*	*51.0%*	Honduras	21.8%	*Russian Federation*	*1.3%*	Thailand	2.2%
21	Hong Kong	254 805	*Mauritius*	*48.0%*	Dominican Republic	21.7%	*Bhutan*	*1.2%*	Indonesia	2.0%
22	Brazil	254 467	*Eritrea*	*45.8%*	Uganda	21.6%	*United Arab Emirates*	*1.2%*	Japan	1.5%
23	Netherlands	240 494	*Ghana*	*42.9%*	Guatemala	21.5%	*Kazakhstan*	*1.1%*	Russian Federation	1.3%
24	Ukraine	237 395	*Mozambique*	*42.0%*	Burundi	19.9%	*Uzbekistan*	*1.0%*	Kazakhstan	1.1%
25	Colombia	232 596	*Marshall Islands*	*41.0%*	Rwanda	19.0%	*Kyrgyzstan*	*0.7%*	Uzbekistan	1.0%
26	Ireland	220 545	*Sierra Leone*	*41.0%*	Serbia and Monten.	17.4%	*Saudi Arabia*	*0.7%*	Kyrgyzstan	0.7%
27	Romania	217 198	*Vietnam*	*39.0%*	Ethiopia	17.0%	*Tajikistan*	*0.7%*	Saudi Arabia	0.7%
28	Peru	183 915	*Liberia*	*37.4%*	United Kingdom	16.7%	*United States*	*0.5%*	Tajikistan	0.7%
29	Pakistan	174 884	*Bahamas, The*	*36.4%*	Tanzania	15.8%	*Oman*	*0.5%*	United States	0.5%
30	New Zealand	172 582	*Micronesia*	*36.4%*	Slovakia	15.3%	*Turkmenistan*	*0.1%*	Turkmenistan	0.1%

Figure 5. Skilled emigration rates by country group

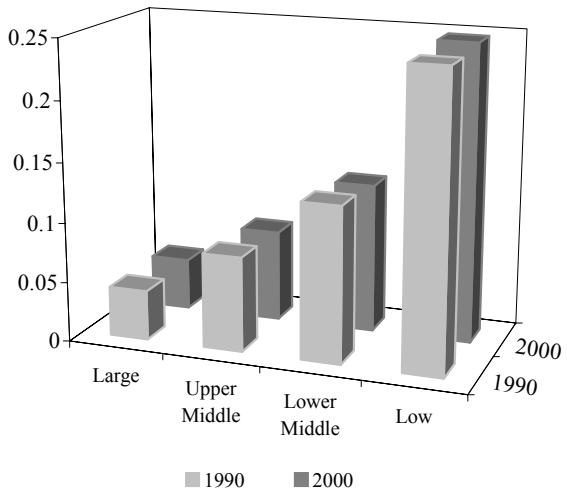
A. Average rate by region



B. Average rate by income group



C. Average rate by country size



5 Conclusion

Due to the poor quality of international data, assessing the economic impact of the brain drain is a challenging issue. Building on the seminal work of Carrington and Detragiache (1998), this paper provides a new dataset on skilled emigration rates describing the loss of skilled workers in both developing and developed countries. By increasing the number of observations and improving their degree of reliability, our method provides useful material for econometric analysis of the causes and consequences of the brain drain.

In absolute terms, we show that the largest stocks of educated emigrants are from Europe, Southern and Eastern Asia and, to a lesser extent, Central America. Nevertheless, as a proportion of the local educated labor force, the highest rates are observed in Central America and Africa (on the Western and Eastern coasts). Between 1990 and 2000, these regions also experienced the strongest increase in brain drain.

Our dataset is obviously evolutionary. It can be improved in several ways:

- This release uses survey data when census data are not available yet. By incorporating new OECD censuses, we will improve the quality of our estimates;
- Adding immigration data from non-OECD countries (Gulf states, South Africa, Eastern Asia) would also strongly improve the quality of our estimates for the major countries involved (Egypt, Jordan, Indonesia, India, Pakistan, Zimbabwe, Namibia.);
- Repeating the exercise for 1980 would also ease the econometric exploitation of the database.

Despite these possible developments, we believe that the current version of our database delivers information that is rich enough to assess the changes in the international distribution of migration rates, to test for the (push and pull) determinants per skill group or to evaluate the macroeconomic consequences of migration on source and destination countries.

References

[1] Adams, R. (2003): International migration, remittances and the brain drain: a study of 24 labor-exporting countries, World Bank Policy Research Working Paper, n. 2972.

[2] Antecol, H., D. Cobb-Clark and S. Trejo (2003): Immigration policy and the skills of immigrants to Australia, Canada and the United States, Journal of Human Resources, 38, 1: 198-218.

[3] Barro, R.J. and J.W. Lee (2000): International Data on Educational Attainment: Updates and Implications, CID Working Papers 42, Center for International Development (Harvard University).

[4] Bauer, T.K. and A. Kunze (2004): The demand for high-skilled workers and immigration policy, Brussels Economic Review, Forthcoming.

[5] Bhagwati, J.N. and K. Hamada (1974): The brain drain, international integration of markets for professionals and unemployment: a theoretical analysis, Journal of Development Economics, 1, 1: 19-42.

[6] Beine, M., F. Docquier and H. Rapoport (2001): Brain drain and economic growth: theory and evidence, Journal of Development Economics, 64, 1: 275-289.

[7] Beine, M., F. Docquier and H. Rapoport (2003): Brain drain and growth in LDCs: winners and losers, IZA Discussion paper, IZA Bonn.

[8] Carrington, W.J. and E. Detragiache (1998): How big is the brain drain?, IMF Working paper WP/98/102.

[9] Carrington, W.J. and E. Detragiache (1999): How extensive is the brain drain, Finance and Development, June: 46-49.

[10] Cinar, D. and F. Docquier (2004): , Brussels Economic Review (special issue on skilled migration), forthcoming.

[11] Commander, S., M. Kangasniemi and L.A. Winters (2004): The brain drain: a review of theory and facts, Brussels Economic Review, forthcoming.

[12] Domingues Dos Santos, M. and F. Postel-Vinay (2003): Migration as a source of growth: the perspective of a developing country, Journal of Population Economics, 16, 1: 161-75.

[13] Dustmann, C. and O. Kirchkamp (2002): The optimal migration duration and activity choice after remigration, Journal of Development Economics, 67, 2: 351-72.

[14] Faini, R. and A. Venturini (1993): Italian migrations: the pre-war period, in Hatton and J. Williamson (eds), International Migration and World Development, 1850-1939, London: Routledge.

[15] Freeman, R.B. (1993): Immigration from poor to wealthy countries. Experience to the United States, European Economic Review, 37: 443-451.

[16] Funkhouser, E. (1995): Remittances from international migration: a comparison of El Salvador and Nicaragua, Review of Economics and Statistics, 77, 1: 137-46.

[17] Grubel, H. G. and A. Scott (1966): The international flow of human capital, American Economic Review, 56: 268-74.

[18] Haque, N.U and S.-J. Kim (1995): 'Human capital flight': impact of migration on income and growth, IMF Staff Papers, 42, 3: 577-607.

[19] Haque, H.U. and A. Jahangir (1999): The quality of governance: second-generation civil reform in Africa, Journal of African Economies, 8: 65-106.

[20] IOM (2003): World migration 2003 - Managing migration, Geneva: International Organization for Migration.

[21] Johnson, H. (1967): Some economic aspects of the brain drain, Pakistan Development Review, 7, 3: 379-411.

[22] Kwok, V. and H. Leland (1982): An economic model of the brain drain, American Economic Review, 72, 1: 91-100.

[23] Lowell, L.B. (2002): Some developmental effects of the international migration of highly skilled persons, Geneva: International Labour Office, International Migration Papers 46.

[24] Lowell, L.B. (2002): Policy responses to the international mobility of skilled labour, Geneva: International Migration Papers 45.

[25] Miyagiwa, K. (1991): Scale economies in education and the brain drain problem, International Economic Review, 32, 3: 743-59.

[26] Mesnard, A. and M. Ravallion (2001): Wealth distribution and self-employment in a developing country, CEPR Discussion Paper DP3026.

[27] Mountford, A. (1997): Can a brain drain be good for growth in the source economy?, Journal of Development Economics, 53, 2: 287-303.

[28] OECD (2002): Trends in international migration, Paris: OECD Editions.

[29] Schiff, M. (1996): South-North migration and trade - a survey, World Bank Reserach and Policy Report, n. 1696.

[30] Stark, O., C. Helmenstein and A. Prskawetz (1997): A brain gain with a brain drain, Economics Letters, 55: 227-34.

[31] Stark, O., C. Helmenstein and A. Prskawetz (1998): Human capital depletion, human capital formation, and migration: a blessing or a 'curse'?, Economics Letters, 60, 3: 363-7.

[32] United Nations (2002): International Migration Report 2002, New York: United Nations.

[33] Vidal, J.-P. (1998): The effect of emigration on human capital formation, Journal of Population Economics, 11, 4: 589-600.

[34] Wong, K.-Y. and C.K. Yip (1999): Education, economic growth, and brain drain, Journal of Economic Dynamics and Control, 23, 5-6: 699-726.

[35] World Bank (1994): Kingdom of Morocco - Poverty, adjustment and growth, Report 11918-MOR.

[36] World Bank (2000): World Development report, Washington: The World Bank.

[37] World Bank (2003): World Development Indicators, Washington: The World Bank.